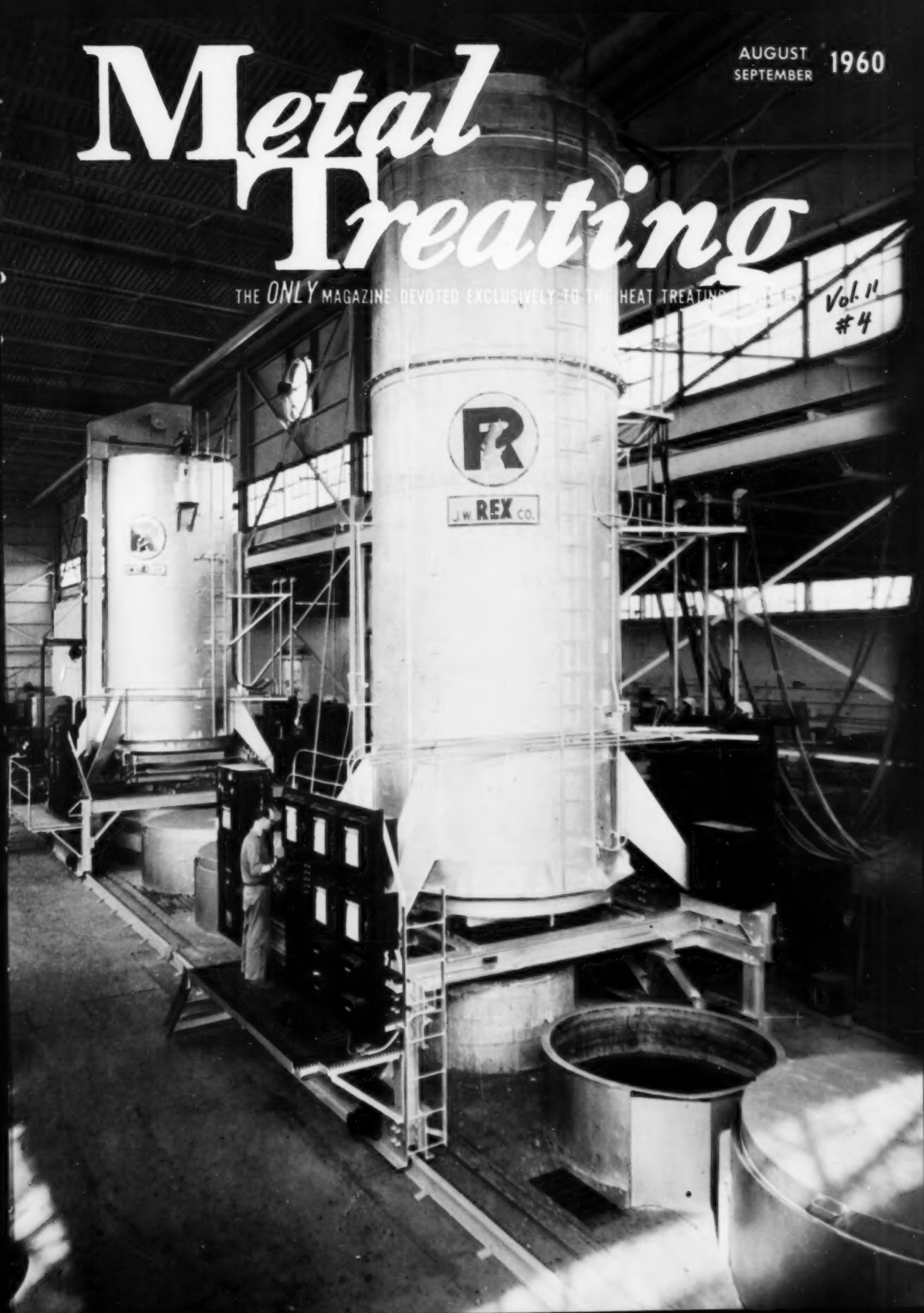


Metal Treating

AUGUST 1960
SEPTEMBER

THE *ONLY* MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

Vol. 11
#4



Quality . . . the best economy of all

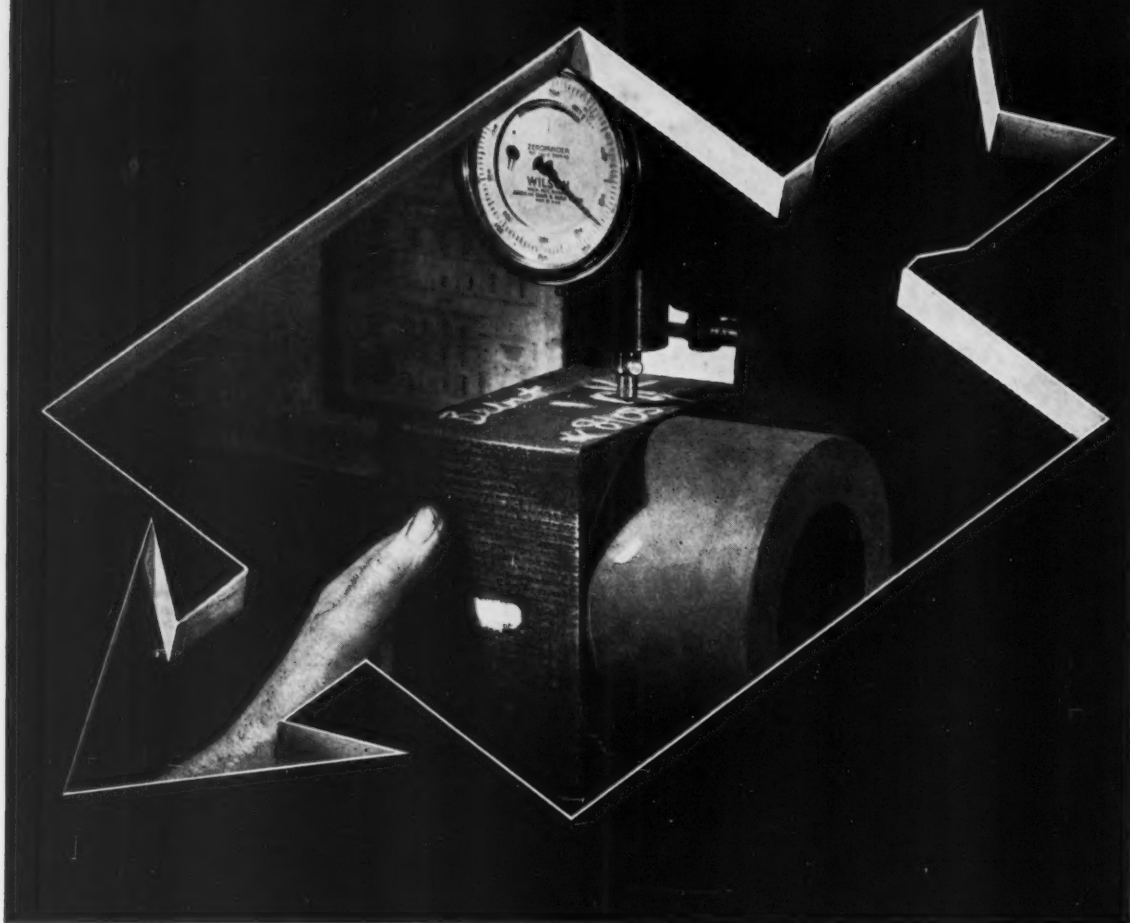


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Metal Treating

THE ONLY MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

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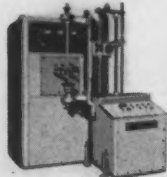
About Our Cover

Special equipment necessary for heat treating important components of rockets and missiles are J. W. Rex Company's contribution in the missile race. For the full story see page 17.

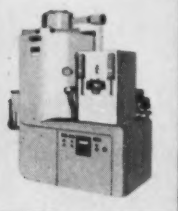
THE BIGGEST INDUSTRIAL HEATING JOB CAN BE ENTRUSTED TO LINDBERG'S *PLUS DIMENSION IN SERVICE*

**THERE'S LINDBERG EQUIPMENT FOR
EVERY INDUSTRIAL HEATING NEED**

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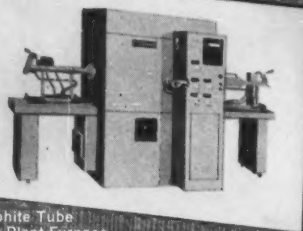
High Frequency Unit
and Zone Scanner



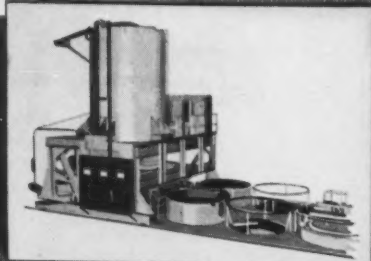
Endothermic
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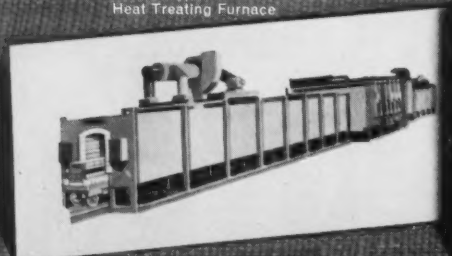
Laboratory
Box Furnace



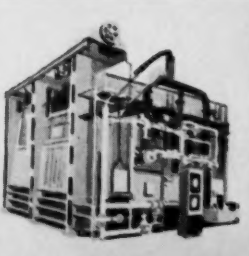
Graphite Tube
Pilot Plant Furnace



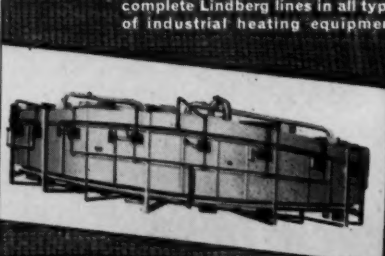
Gantry Type
Heat Treating Furnace



Ceramic Tunnel Kiln



Aluminum Reverberatory
Melting Furnace



Rotary Hearth
Heat Treating Furnace

The plus dimension in service Lindberg offers today can provide a complete answer to any problem requiring the application of heat to industry. Give us your specific requirements for a part or a product and we will develop the right processes, design, engineer and install equipment and facilities.

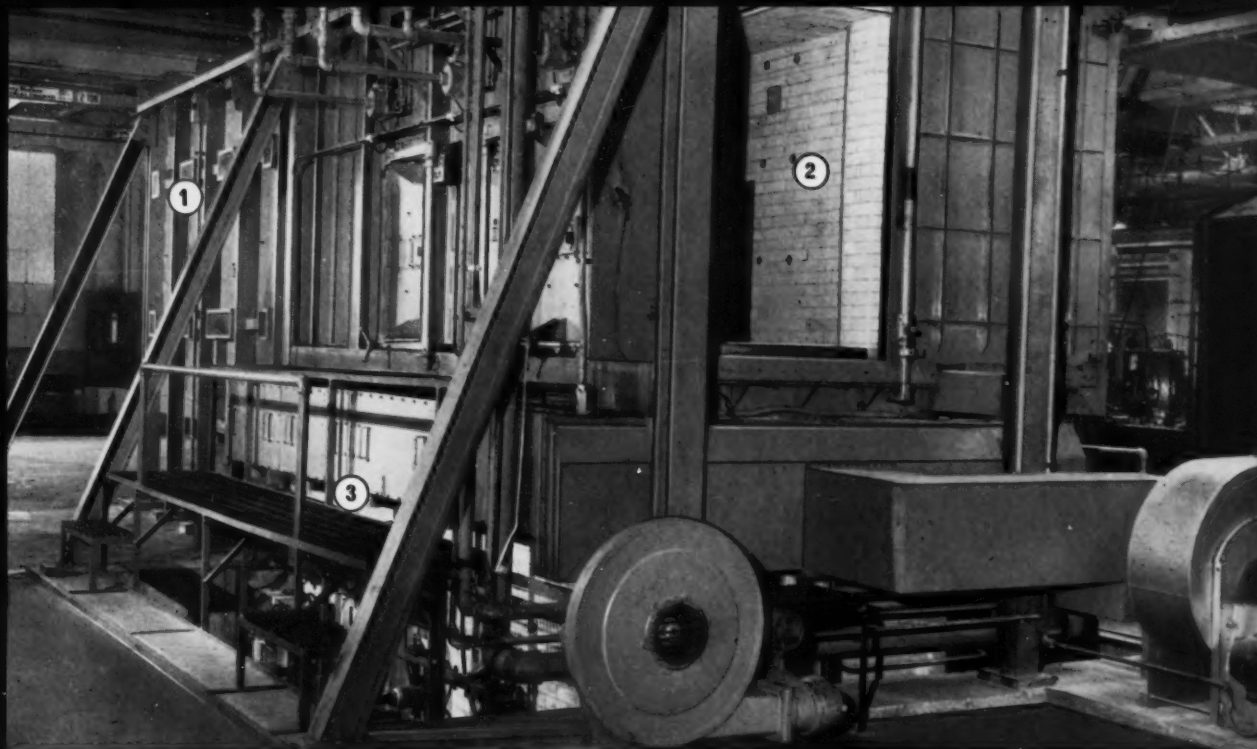
This service covers broad requirements—from plant layout and construction to automated production lines, or just specially engineered industrial heating equipment efficiently integrated into your production processes. For example, Lindberg Industrial Division has recently completed or is in the process of installing such varied projects as:

- Complete plant layout and equipment for brazing honeycomb
- Complete installation for heat treating raw aluminum products including furnaces, foundations, roof and lighting
- A fully automated production line for heat treating plow shares
- Two large ceramic kilns embodying a new concept of making high-refractory bricks
- Complete, automated production line for enameling and drying hot water heaters

You obtain many advantages from Lindberg. You get the combined skills of what we believe to be the country's finest group of engineers and technicians in the industrial heating field. Our experience covers the whole range of "heat for industry" methods so you can rely on us to recommend the most suitable equipment and processes. You will get your installation from one responsible source, guaranteed to achieve the results you need and ready to go to work at the turn of a switch.

Lindberg Industrial Division, Lindberg Engineering Company, 2321 West Hubbard Street, Chicago 12, Illinois. Los Angeles Plant: 11937 South Regentview Avenue, Downey, California. In Canada: Birleco-Lindberg, Ltd., Toronto.

These are representative units from complete Lindberg lines in all types of industrial heating equipment.



This Lindberg installation at Stewart-Warner Corporation, Indianapolis, combines (1) Pre-heat Furnace (2) Holding Furnace and (3) Lindberg-Upton Salt Bath Furnace.

LINDBERG SUPPLIES COMPLETE INSTALLATION FOR DIP BRAZING ALUMINUM HEAT EXCHANGER CORES

Brazing large aluminum plate-and-fin heat exchanger cores requires close tolerances and precise controls. Stewart-Warner Corporation, Indianapolis, chose Lindberg Industrial Division to design and install the right equipment to perform this exacting process efficiently and economically. The main unit, shown above, combines Lindberg Pre-heat and Holding Furnaces and Lindberg-Upton Salt Bath Furnace. Cores are brought to the desired temperature, moved to holding furnace section, then lowered into the salt bath. Automatic controls maintain required salt bath temperature to extremely close limits. Brazed cores are raised

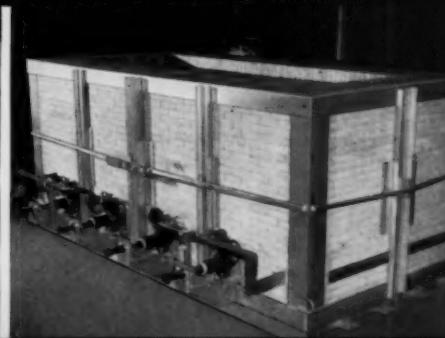
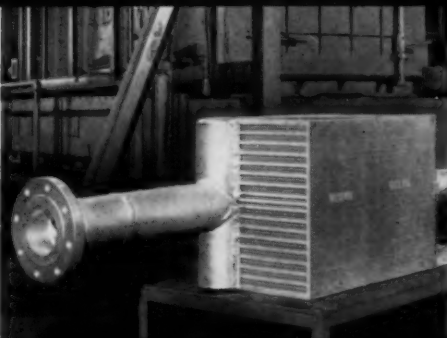
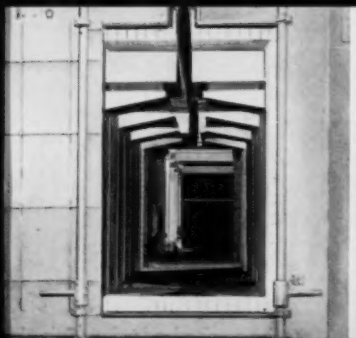
to holding furnace for drainage, moved through a cooling chamber, steam cleaning booth and five dip rinse tanks for thorough cleaning. This installation is another example of the complete design, engineering and installation service Lindberg Industrial Division offers industry. Whenever you have a product or process requiring the application of heat, consult your local Lindberg Field Engineer, (see your phone book) or write us direct. Lindberg Engineering Company, 2466 West Hubbard St., Chicago 12, Illinois. Los Angeles plant: 11937 South Regentview Ave., Downey, California. In Canada: Birleco-Lindberg, Ltd., Toronto.

For further information circle No. 2

Design of unit permits convenient movement of cores through pre-heat (foreground) to holding section (at far end).

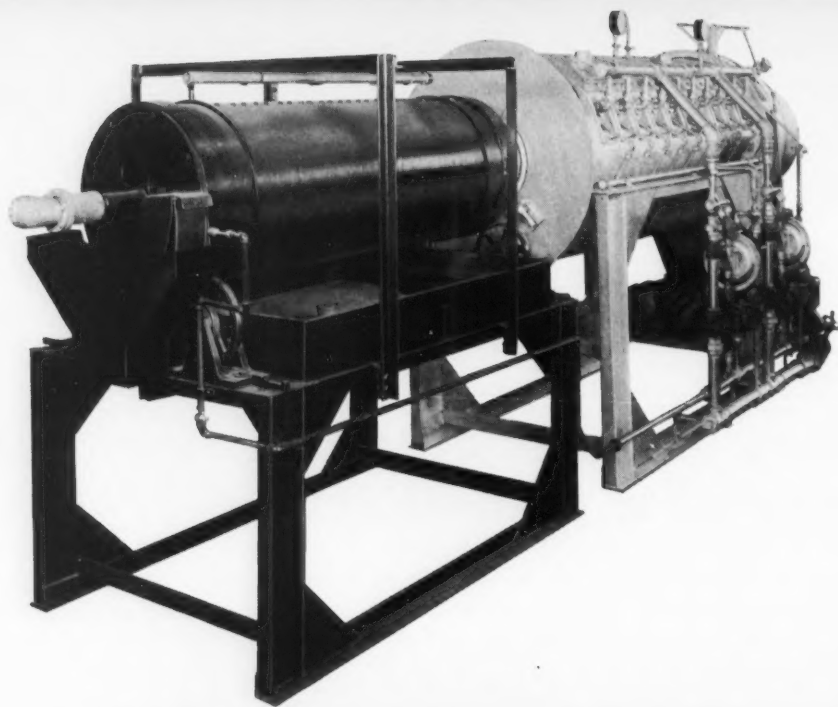
The aluminum heat exchanger cores being brazed in the unit have heat transfer surfaces of 8000 sq. ft. or more.

Lindberg-Upton Salt Bath Furnace in unit features exclusive Graphite "Continuing" Electrodes, and has a capacity of more than 12 tons molten salt.



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For further information circle No. 3

METAL TREATING

FURNACE ATMOSPHERE CONTROL WITH CONTINUOUS GAS ANALYZERS

L. E. MALEY
Technical Products Division
Mine Safety Appliances Company

Metal treating processes are in a period of transition with respect to instrument control of furnace atmospheres. Increasingly rigid specifications and metallurgical requirements, which cannot be met with spot check instruments, are being met when the analysis of furnace atmosphere is under continuous observation and control by instruments.

At one time the use of instruments for continuous measurement and control of temperature went through similar stages of adoption in this field. It is now universally agreed that instruments for this purpose greatly improve the metallurgical changes that are produced in metals. Precision temperature controllers of recent development have given outstanding performance in this respect.

The influence of furnace atmosphere is often more vital to the properties of a metal than temperature. Continuous checking of significant components by analyzing instruments, and either automatic or manual adjustments of atmosphere generators or associated equipment, are giving good reproducible results in heat treatment. They are also reducing costs significantly because these instruments can:

1. Prevent oxidation of ferrous and non-ferrous metals during heat treatment.
2. Control carbon content in carbon steels and steel alloys in carburization and decarburization processes.
3. Control the amount of carbon added to the surface of steel in gas carburizing.
4. Prevent oxidation of metals being furnace brazed.

Mass production scale heat treating of a wide variety of machine parts is practical with accurate control of atmosphere because it can be done without gain or loss of surface hardness, eliminating further grinding or cleaning costs. This has been done with aircraft

parts that meet rigid specifications. The elimination of oxidation has saved the costs of expensive pickling and cleaning operations. Adoption of this type of instrumentation has passed the experimental stage and there are now a number of successful installations of instruments that continually maintain predetermined composition of furnace atmospheres. Much of the work being done today on parts for jet aircraft, missiles, etc., must meet such exacting requirements that continuous gas analyzers on the furnace are included in the original specifications.

Types of Gas Analyzers

There are four basic types of continuous gas analyzers that are applicable to furnace atmosphere control. Applications of each depend on the gas to be regulated, the type of atmosphere in the furnace and the accuracy required. The four types are:

1. Combustible gas analyzer (for carbon monoxide, hydrogen, and traces of unburned fuel from the generator).
2. Infra-red analyzer (for carbon monoxide, carbon dioxide, methane, water vapor or dew point).
3. Thermal conductivity analyzer (for hydrogen and carbon dioxide).
4. Oxygen analyzer.

Since the effects of heat treating temperatures depend on the metal and the atmospheres for various metallurgical processes, unvariable atmospheres are necessary if the desired appearance or structure of the metal is to be held uniform. Consequently, instrument control of the atmosphere generator or gas scrubbers is desirable.

Three types of generators are commonly used in the United States, although several other types are in use



FIG. 1. This is one of three M-S-A Inert Gas Analyzers used to control furnace atmospheres for annealing copper in the C. G. Hussey Company plant in Pittsburgh. L. A. O'Donnell, superintendent, said this fully automatic analyzer and recording controller ensures a clear, bright, smooth product and "has saved us countless headaches." The controller operates a proportioning valve that regulates the fuel-gas/air mixture to the generator.

around the world. These are the exothermic and endothermic generators, and the ammonia dissociators.

Exothermic generators are used most extensively because of their simplicity and the wide range of atmospheres they can produce. Fuels used are usually natural gas, propane, butane or manufactured gas, combined with air. Carbon dioxide and water vapor are usually removed from the generated atmospheres in order to make a high nitrogen reducing atmosphere in which the amount of carbon monoxide and hydrogen can be controlled. Gas analysis is controlled through the fuel gas-air ratio, as dictated by the metallurgy of the products and the selected heat treatment, and may be made fully automatic.

Endothermic generators react a gas-air mixture at a high temperature which produces atmospheres high in hydrogen and carbon monoxide; low in carbon dioxide, methane, and water vapor. Control can be made automatic when desired, following signals from the analyzer.

The products of an ammonia dissociator, a mixture of one part nitrogen and three parts hydrogen, may be used as furnace atmosphere without other additions, or air may be added to burn and produce high nitrogen and low hydrogen atmospheres.

Analyzer Performance

The choice of the type of analyzer for a given application can be made on the basis of the performance of each.

The M-S-A combustible gas analyzer is a hot wire type instrument that utilizes the effect of the heat of combustion of combustible gases in a sample, on the electrical resistance of the hot wire. In generator products, there are hydrogen plus carbon monoxide and usually traces of unburned fuel. Indicators and recorders are calibrated to read percent combustibles in ranges of 0-1% to 0-10% combustibles. Instruments are designed for specific applications, usually with the control range centered on the scale. If the gas gets too lean or too rich, the control mechanism is actuated automatically to correct the composition. Manual control is also provided for use if the automatic control system does not operate. In many applications the manual control alone has proved adequate.

The M-S-A Lira infra-red analyzer is a sensitive and stable analyzer which operates on the principle of absorption of portions of the infra-red spectra by various gases. The pattern of absorption differs for each gas and the degree of absorption depends on the concentration in a mixture. For furnace atmosphere control the instrument might be used to measure very low concentrations of carbon dioxide, carbon monoxide, or water vapor.

A potentiometer recorder of any model may be made an integral part of this analyzer system. It can also incorporate controller functions.

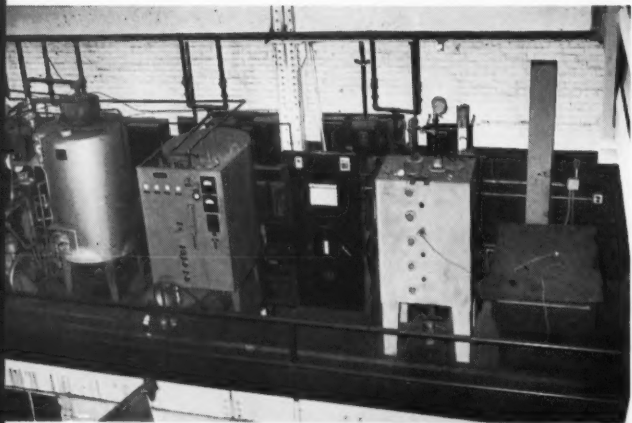


FIG. 2. The effect of methane in furnace atmospheres on heat treatment of steel was investigated by Lindberg Engineering Company with the aid of the M-S-A LIRE infra-red analyzer (center). An accuracy of .01% during continuous measurement of methane, which was present in quantities of 0-1%, was reported.

This instrument is a non-dispersive selective type analyzer. Sources of radiation are two similar heated Nichrome filaments. Beams pass through parallel cells alternately, one containing the sample gas, the other a selected comparison gas. Emergent radiation enters a detector cell and causes the enclosed gas to expand in relation to the amount of radiation absorbed. Expansion of the gases causes a measurable movement of a membrane mounted in the detector cell. Only variations in radiation intensity to the detector cell produce an output signal through the amplifier. This signal is proportional to the difference between the two radiation beams. The recorder-indicator is calibrated in concentration of the analysis component.

The M-S-A Lira infra-red analyzer can be used also to measure dew point, both very narrow ranges such as -100 F. to -30 F. or wide ranges such as -100 F. to +90 F. Filament temperature depends upon the temperature of a wire or filament heated by a constant electric current.

M-S-A Thermatron

Since oxygen and hydrogen do not absorb infra-red energy, either a thermal conductivity analyzer such as the M-S-A Thermatron, or an oxygen analyzer must be used for such analyses. The Thermatron is also useful in measuring carbon dioxide.

The M-S-A Thermatron combines thermal convection-interfering components or otherwise altering the sample gases. This is accomplished without scrubbing out without interference from significant variations in other tion with thermal conduction principles which can make the instrument selective to one gas in a mixture depends on the rate at which heat is dissipated to cooler cell walls by conduction through the gas. M-S-A Thermatron cells emphasize heat transfer by conduction while minimizing other effects. A unique combination of thermal convection with thermal conductivity cells makes these measurements possible with high accuracy—within 2% of full scale—and selectivity. Any available recorder can be used with the instrument, since it has a DC millivolt output.

This instrument can measure hydrogen in a furnace atmosphere containing nitrogen, carbon dioxide, carbon monoxide, and other gases. It can also be used to measure carbon dioxide accurately in the presence of hydrogen.

An oxygen analysis is usually advisable in an atmosphere where safety is a factor or oxidation must be prevented. An electrochemical method is used in all M-S-A oxygen analyzers. The detector in these instruments is a galvanic cell of special and highly advanced design. It has a metal anode and a tubular carbon cathode with most of the outside surface covered with an insulating material. Both are immersed in an electrolyte with a relatively high hydrogen ion concentration. Flow of electric current causes hydrogen

ions to go to the carbon cathode and polarize it, which quickly drops electromotive force to zero, unless counteracted. Oxygen will do this. If there is oxygen in a gas sample which is conducted through the carbon cathode tube, it diffuses through the carbon wall and reacts with the hydrogen ions, decreasing polarization and producing a measurable electromotive force and electric current.

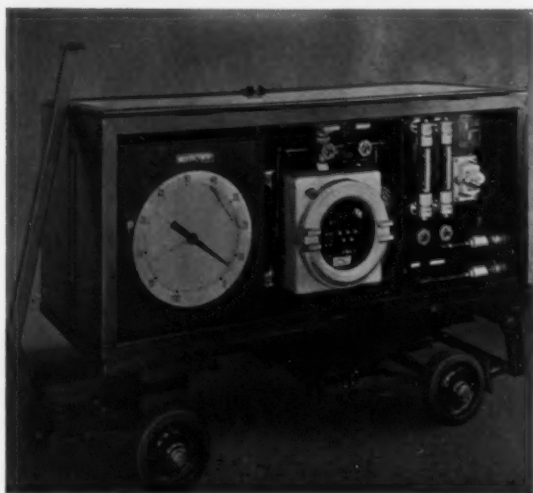


FIG. 3. Mobile M-S-A Combustible Gas Analyzers like this one are in use in plants of three of the largest corporations in the United States. They provide for monitoring of any one of several furnaces or gas generators when they are not in use simultaneously.

FIG. 4. Hydrogen can be measured in furnace atmospheres containing nitrogen, carbon dioxide, carbon monoxide, and other gases with this thermal conductivity instrument. It can also be used to measure carbon dioxide accurately in the presence of hydrogen.





FIG. 5. Absorption of portions of the infra-red spectra by various gases in furnaces atmospheres is used to measure very low concentrations of carbon dioxide, carbon monoxide, methane, or water vapor. In a continuous analyzer system the indicator could be supplemented by a potentiometer recorder in which controller functions could be incorporated.

Standard ranges of the instrument are 0-1%, 0-5%, 0-10%, and 0-25% oxygen. Automatic calibration is now provided for continuous instruments, frequency being determined by the required precision of analysis, and the drift conditions of the application.

A portable oxygen indicator based on the same detector cell is also made by M.S.A. It can be utilized in checking the oxygen content of generator gases and guiding the control of the fuel air ratio. Accessories include a line trap assembly for collecting condensed water, or to be filled with acid gasorbent if samples are contaminated with strongly acid products such as hydrogen sulfide or sulfur dioxide.

Instrument Applications to Annealing Operations

1. *Steel wire.* To prevent excessive decarburization, control of the furnace atmosphere scrubber system is guided by an infra-red analyzer which guards against excess CO_2 in samples of gas leaving the scrubber system.

2. *Tin strip.* Infra-red analyzers measure CO_2 and water vapor which can deteriorate the product if allowed to be excessive in the furnace atmosphere.

3. *Tin plate, bright annealing.* To insure little or no carbon monoxide or carbon dioxide, an infra-red analyzer will measure both and assure proper control.

4. *High carbon and alloy carbon steels.* A balanced atmosphere containing 3-4% CO and approximately the same H_2 , can best be measured and/or controlled by a hot wire type analyzer such as the M-S-A Combustible Gas Analyzer.

5. *Tool steel.* The hot wire type analyzer can be used as in No. 4, above, to keep CO and H_2 in the 5-6% range.

TABLE 1. Applications — Continuous Gas Analyzers

Atmosphere Type	Avg. Composition (Methane as Fuel)	Gases to be Controlled	Metallurgical Application	Instruments for Control
1 Exothermic (Lean)	CO_2 — 10% CO — .5% H_2 — .5% CH_4 — 0% O_2 — 0% N_2 — 89%	1. O_2 , H_2 sometimes CO , CO_2	1. Brazing of Copper or Brass Bright Annealing of Copper or Brass	1. C.G.A.* I.R. O_2
		2. O_2 , H_2O , CO , CO_2	2. Annealing of Stainless Steels	2. I.R.* O_2
1A Exothermic (Lean) H_2O , CO_2 Removed	CO_2 — 0% CO — .5% H_2 — .5% N_2 — 99%	1. O_2 , CO , H_2 CO_2 , H_2O monitored for removal	1. Bright Annealing of Ferrous Metals	1. I.R. O_2 C.G.A.*
2 Exothermic (Rich)	CO_2 — 5% CO — 10% H_2 — 15% CH_4 — 1% N_2 — 69% O_2 — 0%	1. O_2 , H_2 , CO , CO_2	1. Brazing Low Carbon Steels	1. O_2 , C.G.A.*, I.R.
		2. CO , H_2	2. Sintering Low Carbon Steels	2. C.G.A.
		3. O_2	3. Tempering of All Ferrous Metals	3. O_2
		4. CO , H_2	4. Bright Annealing of Low Carbon Steels	4. C.G.A.
2A Exothermic (Rich) H_2O , CO_2 Removed	CO_2 — 0% CO — 10% H_2 — 15% CH_4 — 1% N_2 — 74%	1. CO , H_2	1. Annealing of Alloy Steels with no Decarburization	1. C.G.A.*, I.R.
		2. CO , H_2 CO_2 , H_2O monitored for removal	2. Sintering of Medium and High Carbon Ferrous Metals	2. C.G.A.*, I.R.

* Most likely to be used or required.

6. *Stainless steel.* Since no oxygen can be tolerated, and a pure dry hydrogen atmosphere is commonly used, an oxygen analyzer and a thermal conductivity analyzer for H₂ purity provide controls. To guard the surrounding air against hydrogen leakage, a combustible gas analyzer is recommended.

7. *Copper, bright annealing.* A reducing atmosphere with 1% or less hydrogen can be maintained by a hot wire type combustible gas detector.

8. *Brass.* Normally water vapor and CO₂ are scrubbed out to avoid oxidation. The infra-red type analyzer, installed after both scrubber and drier, offers the most advantages.

Copper alloys, not including zinc, aluminum, and beryllium, are annealed in either rich or lean exothermic gases. Since water vapor and CO₂ are not critical, a hot wire analyzer for combustible gases is adequate.

Precious metals, such as gold, silver, and platinum, can be annealed in lean or rich exothermic atmospheres without further purification. Lower karat gold alloys, usually containing zinc, require minimizing water vapor. Infra-red type analyzers can be used to monitor gas driers.

Instrument Applications to Hardening Operations

1. *Steels, bright hardening.* Elimination of finish machining or grinding, cleaning, sand blasting, or de-scaling depend on control of dew point and minimizing

carbon dioxide and methane. An infra-red analyzer is best for this application.

2. *High carbon, chromium and stainless steels.* If some discoloration or slight oxidation is permissible, a hot wire type analyzer for combustible gases is satisfactory. If bright surfaces are required, all oxygen bearing components must be removed and an infra-red type analyzer will monitor the CO and dew point after the scrubbers.

The slight carburizing potential needed in heat treating steel wire can be controlled by using an infra-red analyzer to measure and/or control CO content.

To prevent decarburization of metals for transformer cores and motor armatures, an infra-red analyzer for measuring water vapor will assure changing driers before the water content of the high hydrogen atmospheres gets high enough to cause rejects.

Atmospheres required for furnace brazing are almost the same as those for bright annealing, and the same control instruments are suitable.

Sintering atmospheres are highly reducing. A rich exothermic gas atmosphere is used for brasses and bronzes. High nitrogen, with controlled amounts of CO and H₂ with or without CO₂ and H₂O vapor, make the combustible gas analyzer suitable.

If oxidation of chrome must be prevented, the high purity, dry hydrogen or dissociated ammonia atmosphere which must be used, can be controlled by the infra-red or thermal conductivity type analyzer.

TABLE 2. Applications — Instruments

Atmosphere Type	Avg. Composition (Methane as Fuel)	Gases to be Controlled	Metallurgical Application	Instruments for Control
1 Endothermic (Lean)	CO ₂ — 1% CO — 18% H ₂ — 34% CH ₄ — 1% N ₂ — 46%	1. O ₂ , CO ₂ , CO, H ₂ O, H ₂	1. Annealing of Chromium and Stainless Steels	1. O ₂ I.R.* T.C.
2 Endothermic (Rich)	CO ₂ — 9% CO — 19% H ₂ — 40% CH ₄ — 1% N ₂ — 69%	1. CO, H ₂ , H ₂ O 2. CO, H ₂ , H ₂ O 3. CO, H ₂ , H ₂ O 4. CO, H ₂ , H ₂ O	1. Brazing of High and Medium Alloy and Carbon Steels 2. Sintering of Ferrous Steels 3. Carburizing and Carbonitriding Ferrous Metals 4. Bright Hardening and Tempering of Carbon Steels	1. 2. 3. I.R.*, T.C. 4.
3 Dissociated Ammonia	H ₂ — 75% N ₂ — 25%	1. 2. H ₂ , H ₂ O 3.	1. Brazing of Chromium and Stainless Steels 2. Sintering of Stainless Steels and Tungsten 3. Bright Hardening and Tempering of High Speed Tool Steels	1. 2. I.R.*, T.C. 3.
4 Dissociated Ammonia (Rich Combusted)	H ₂ — 20% N ₂ — 80%	1. H ₂ , H ₂ O	1. High Temperature Annealing of High Silicon Steels	1. I.R.*, T.C., C.G.A.
4A Dissociated Ammonia (Lean Combusted)	H ₂ — 1% N ₂ — 99%	1. H ₂ , H ₂ O 2. H ₂ O, H ₂	1. Annealing of some Ferrous Metals 2. Inert Blanketing and Purging	1. C.G.A., I.R.*, T.C. 2. C.G.A.*, I.R. T.C.

* Most likely to be used or required.

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Douglas Aircraft Company
Long Beach, California

Due to the impossibility of anticipating everything that can go wrong with a furnace, such maintenance necessitates the use of remedial as well as preventive techniques. However, we firmly believe that preventive maintenance is usually the most satisfactory way to minimize furnace downtime, assure high quality with minimal rejects, and reduce operating costs in general.

The basic phase of our preventive maintenance program consists of having properly trained electricians check the instrumentation for each of our heating units twice during the course of every eight hour shift. In addition, we have each instrument cleaned, oiled, and calibrated once daily.

For the standardization of controllers, the electricians use the known emf. of a Brown K-potentiometer. Where there is any evidence of erratic performance, production instruments are replaced by spares until the former can be thoroughly overhauled and tested in a Douglas owned laboratory which is specially equipped for such work.

Since quick disconnect plugs and receptacles make it a fast and simple matter to install substitute instruments, and since we have adequate supply of spares that have been functionally tested, we feel that extensive on-the-line test and repair efforts could only lead to excessive furnace downtime.

The general performance of each furnace is functionally tested once a week by loading thermocouples on an empty parts rack—in dispersed positions at the rate of one thermocouple for every 15 cu. ft. of work space in the furnace—and using thermocouple leads to make a record with a multipoint recorder.

Once each weekend, our fail-safe instrumentation is also checked to determine its reliability.

Satisfactory thermocouple performance is generally assured by replacing all thermocouples at intervals averaging about 45 days. The exact period of time depends on the temperatures at which different furnaces are operated.

Preventive maintenance for blowers involves the once-a-year cleaning of motor windings and the replacement of such parts as bearings, insulating varnish coatings, and worn drive pulleys.

Remedial maintenance for many obvious discrepancies, such as damaged brick insulation in vertical-lift furnace doors, is often requested by production

[illegible]

FIG. 1. This page from Douglas Process Specifications indicates the type of "case history" that is kept with reference to the instrumentation for each of Douglas' heat treat furnaces.

personnel. More subtle deficiencies are usually detected by quality control workers who naturally refer to the strip chart accompanying a given load when parts fail to meet requirements.

One of the more complicated remedial maintenance jobs that we have handled involved a quick-quench heat treat furnace for wrought aluminum alloys which was unable to hold close-tolerance temperatures some six years after it was originally installed. Since temperatures at the north-end blower stack were running about 20 F. higher than those at a corresponding point in the south-end blower stack, we concluded that the trouble in this case was due either to differing blower operational characteristics or to leakage in furnace insulation or ducting.

By using titanium tetrachloride, or liquid smoke, as a leak detection medium, we were able to locate holes and loose joints in the furnace return ducts, deteriorated gaskets in the entire air circulating system, and defective roof and stack insulation. However, while this made it evident that some of our trouble was the result of ineffective insulation, we were unable to rule out the blower problem.

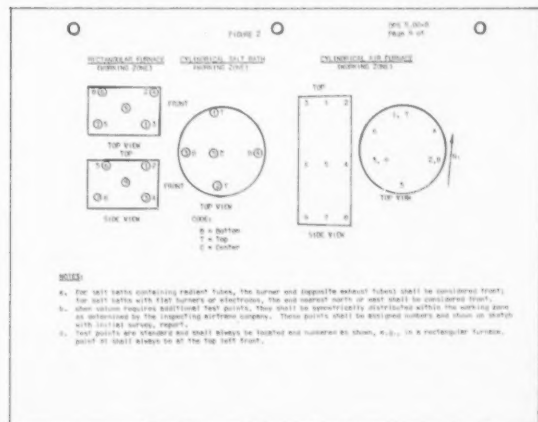


FIG. 2. This page from Douglas Process Specifications shows typical thermocouple arrangements used in functionally testing different types of furnaces once each week.

Because the furnace had an abundance of heat input—rapid recovery time—and because it was not mechanically feasible to increase heat in the cold end, we decided to cool down the hot end by cutting a hole in the top of each intake blower plenum to permit the addition of 4 in. diameter, 14 in. long stainless steel stacks in such a way that they would project 6 in. above the plenum insulation. A damper arrangement, which was subsequently used, made it manually possible to vary the stack openings so that any desired quantity of outside air could enter and cool air circulated by the hot end blower.

Prior to replacing defective insulation, we removed all old insulation from the furnace roof and plenums,



FIG. 3. Maintenance electrician makes one of two daily checks on instrumentation for furnace installed in Douglas Aircraft's Long Beach plant.



FIG. 4. Thermocouples are arranged on parts rack prior to the functional testing of a furnace in Douglas Aircraft's Long Beach plant.



FIG. 5. Furnace strip charts, incorporated in batches of heat treated parts as indicated in the center foreground of this picture, make it possible to determine when remedial furnace maintenance is needed in Douglas' Long Beach plant.



FIG. 6. M. A. Miner, author of this report, inspects a load of heat treated stampings to obtain clues regarding furnace performance.

patched holes and loose joints in the latter components, renewed all gaskets in the air circulating system, and grouted cracks with high temperature mortar. A 3 in. thick layer of glass fiber was installed around the perimeter of the furnace roof, on which two 4 in. thick layers of mineral wool cement and two layers of Hex Mesh were alternately placed and covered with a 3 in. thickness of mineral wool cement mixed with 20% Portland cement. Purpose of the use of Hex Mesh and mineral wool cement was to restrict the depth of any subsequent cracks to a maximum of 4 in. In addition, plenums or blower stacks were insulated with metal lath, 2 in. of Kaylo Block, 6 in. of TWF Armaglas, and $\frac{1}{2}$ in. of cement.

The furnace was next brought up to operating temperature over a period of three days, thereby allowing it to dry without damaging the insulation. All small cracks were filled and the plenums were covered with asbestos cloth and coated with Insulcolor.

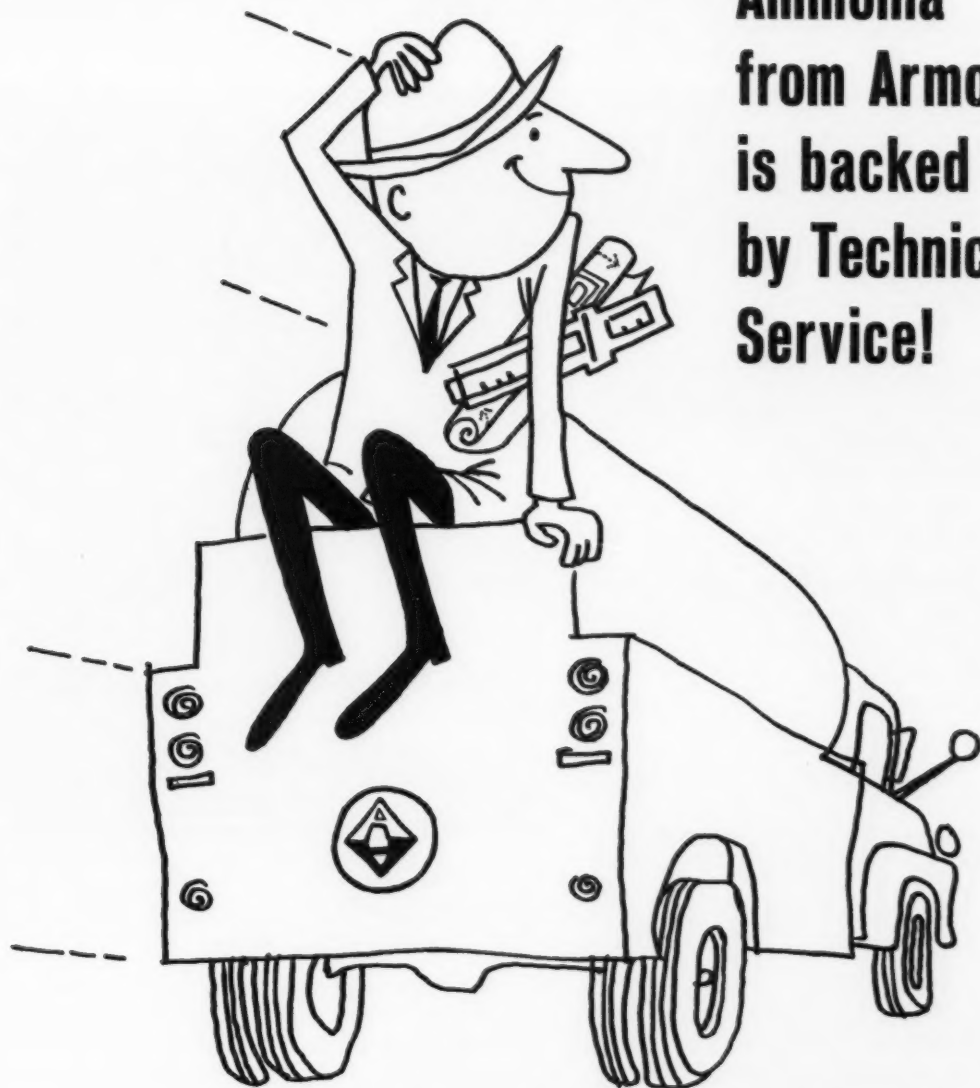
Liquid smoke testing was done to assure the proper adjustment of hot air diverters, which were later secured with sheet metal screws. The fan control mechanism through the plenums and the vertical face of the plenums were stiffened with $1\frac{1}{2}$ in. angle bar to prevent sheet metal "breathing." This deviation had previously caused insulation to crack and pull away from the fan housing. Bottom door gaskets were re-secured, or renewed where necessary, and walking platforms with guard rails were installed on top of the furnace to protect the roof insulation.

After final instrumental adjustments and calibrations were made, thermocouple probes were inserted in the furnace blower plenums to permit the equalization of temperatures with stack dampers. Periodic checks were made to determine if outside temperature changes would effect the resultant damper adjustments, but no deviations in temperatures were noted. This was possibly due to controlled air in the building that houses the furnace.

From the time the instruments came up and all thermocouples were in tolerance, it took ten minutes for calibrated areas to come to operating temperatures — at which time readings ranged from 916 to 923 F. In 15 minutes, the readings were 918 to 924 F.; and in 20 minutes after reaching control, they were 919 to 926 F. — or $\pm 3\frac{1}{2}$ F.

Our records indicate that, when it was brand new, the same furnace could not hold temperatures closer than ± 5 F. • • •

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of ammonia-derived atmospheres for heat treating.

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For further information circle No. 4

NEW HEAT AND COLD TREATMENT

THOMAS A. DICKINSON
Los Angeles, California

Hard-to-handle stainless steel components are retaining close tolerance dimensions in the finished condition, thanks to a new heat-and-cold processing technique developed by Boeing Airplane Company's Aero-Space Division.

Known as cryoforming, it is said to be suitable for parts comprising PH 15-7 Mo, PH 17-7, AM 350, and AM 355 alloys.

The latter steels have very high strengths when heat treated. Their strength-weight ratio at temperatures up to 800 F. compares quite favorably with that of most other materials which are now commercially available. They do not, however, have the best fabrication characteristics.

When they are being machined or stamped, for instance, they often develop residual stresses; and, due to the release of such stresses during subsequent heat treatments, parts may be severely warped or deformed. In some instances, the deformed parts can be manually or mechanically straightened. This, at best, is a costly process.

The main purpose of cryoforming is to eliminate warpage without sacrifice of desired properties in heat treated parts at minimum cost.



FIG. 1. After being cryoformed, stainless steel parts can be furnace aged without restraining tools, as illustrated here.



FIG. 2. Cold box containing dry ice and trichloroethylene produces sub-zero temperatures in die-retained parts during the final stage of cryoforming.

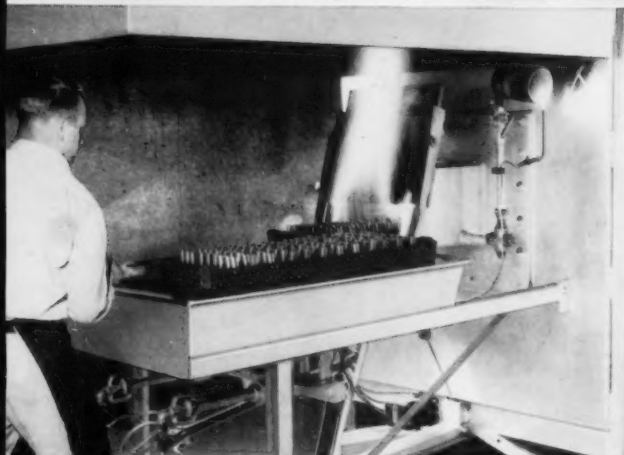
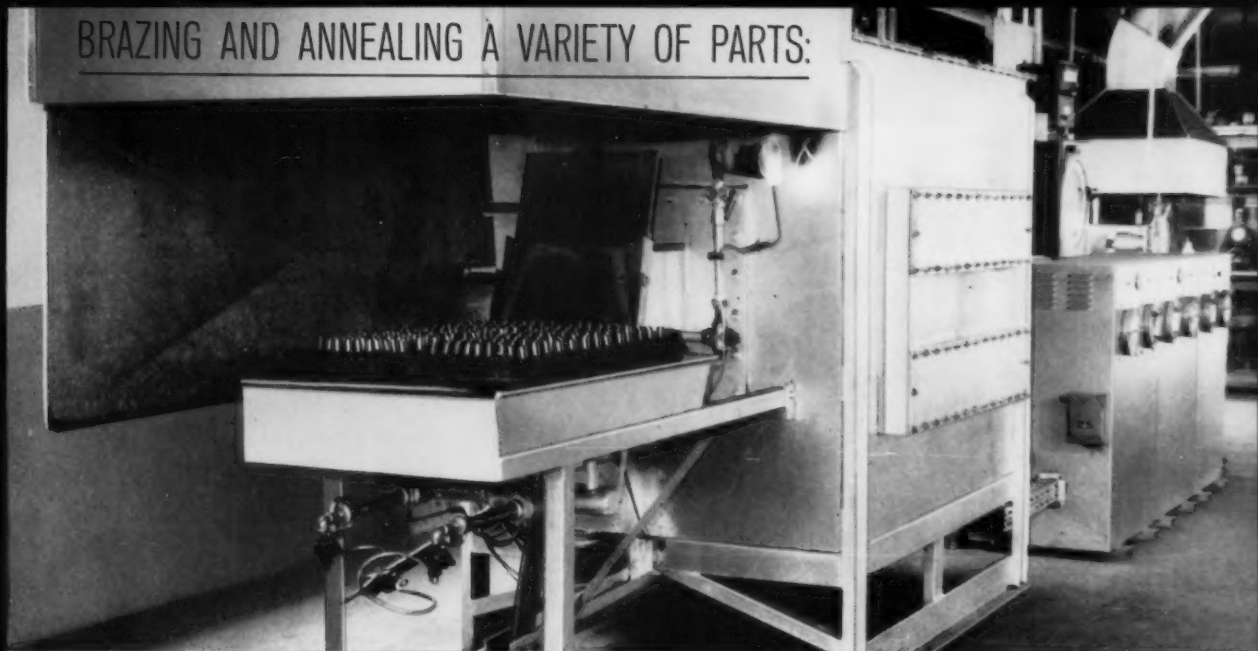
During the process, a part is initially hardened at 1,725 F. in a more or less conventional manner. It is then cooled to a temperature slightly above 200 F., and forced into a preheated sizing die which has facilities for retaining the part throughout the remainder of the quenching cycle.

Part and die temperatures are gradually lowered during the latter period until a sub-zero temperature is attained in a cold box which uses dry ice and trichloroethylene as a refrigerant. Result of this is a change in crystalline structure which is characterized by the complete and permanent realignment of carbon and iron molecules in the part.

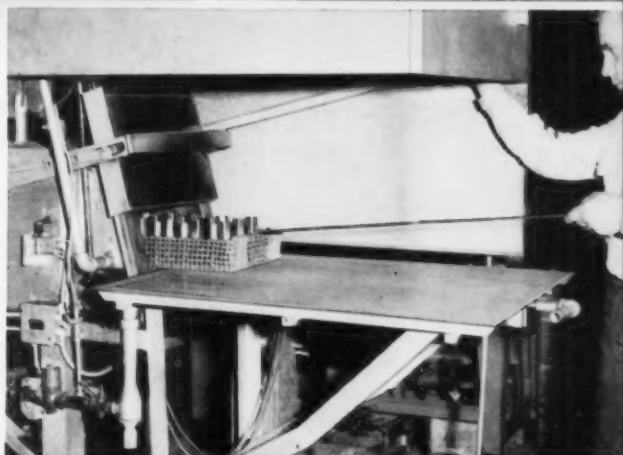
Sub-zero temperatures employed by Boeing in this connection range from -40 to -110 F. They are produced in periods of 40 to 60 min., just long enough to bring about what is believed to be a condition of momentary pliability or plasticity, which allows metal

Continued on page 41

BRAZING AND ANNEALING A VARIETY OF PARTS:



Basket of parts is pushed from the end table through gas flame curtain of charging door into heating chamber. The charging door and inner refractory doors of heating chamber are pneumatically-operated.



Clean, bright brazed parts are drawn from the water-jacketed cooling chamber at the exit end of furnace. In this instance, four baskets can be cooled while one basket is being treated in the heating chamber.

COSTS MINIMIZED IN BUSY JOB SHOP

Processing metal parts for several manufacturers on a contract basis, Edward E. Russell Co., Wallingford, Conn. uses two Harper box furnaces for brazing with copper and silver alloys as well as for annealing. Parts from 1/4" in diameter up to 11" x 7" x 36" are treated at temperatures up to 2350°F. Each furnace handles up to 200 lbs./hr. net.

The first Harper furnace (shown above) went into operation in 1951 and the second during 1953. Both have been in continual use since installation with practically no lost time for maintenance.

The company reports that the furnaces have "not only proved extremely economical, but are exceptionally versatile, easy to control and productive of high quality work."

The next time you're considering the purchase of a

furnace for brazing, sintering or annealing, you'll find it worth your while to discuss job requirements with a Harper representative... for Harper can build the furnace best suited to your needs: box, pusher, mesh belt hump or straight-thru, roller hearth, bell, elevator or pit. To obtain detailed information, write: Harper Electric Furnace Corporation, 51 River St., Buffalo 2, N. Y.

HARPER ELECTRIC AND GAS FURNACES

FOR BRAZING, SINTERING, BRIGHT ANNEALING, AND FORGING IN RESEARCH AND PRODUCTION

For further information circle No. 5



PART: Welded bellows-type seal. **MATERIAL:** Type 410 Stainless Steel. **SPECIFICATIONS:** To be hardened under close control because of variations in metal sections. Finished assembly to be clean, bright and free from oxides and scale. Seal in photo has been cut to show cross section of the bellows-type seal.

How would you heat treat a part like this?

The stainless steel bellows-type seal shown is used in a number of applications, from refrigerating systems to missiles, where mechanical seals are needed to resist extreme temperatures from -400°F to $+1200^{\circ}\text{F}$. Heat treatment is complicated by the wide variation in section between the thin bellows and the much heavier outer rings.

The Sealol Corporation, Warwick, R. I., solves the problem with a Hayes electric furnace equipped with GLOBAR[®] silicon carbide heating elements. Depending on the material of the welded bellows (stainless steels of the 300 and 400 groups, precipitation hardened steels such as AM350, 17-7PH, Inconel X, etc.), hardening is between 1700°F and 1900°F , followed by muffle cooling, both in a hydrogen atmosphere.

GLOBAR elements make possible the precise temperature control and clean heat, independent of the atmosphere, required in this critical operation. Rod-type element simplifies design, furnace construction and servicing. Losses are minimized because all heat is produced and contained inside the furnace.

The many advantages of heating with GLOBAR elements often more than cancel out differentials in BTU costs between electricity and other fuels. Why not investigate with your furnace builder—or write to Refractories Division, Globar Plant, Dept. MP-60, The Carborundum Co., Niagara Falls, N. Y.

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For further information circle No. 6

For precise, economical
electric
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GLOBAR
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- Shipped from stock or within two weeks.
- Temperatures from 1400 to 2800°F , precisely controlled, independent of atmosphere.
- Easily replaced from outside without waiting for furnace to cool.
- "On line" operation for many applications—no transformer necessary.
- Rods $4"$ to $105"$ in length.
- For greater economy in heat treating, brazing, forging, melting, and sintering.

ABOUT OUR COVER

The missile and rocket race between major world powers assumes greater importance with every passing year. As its contribution to this important field J. W. Rex Company, Lansdale, Pennsylvania, a pioneer in this field, has again expanded its facilities to meet the growing demand for heat treating of many components which go into rockets, missiles, and nuclear equipment. Following is a report of how one industry member is meeting the demands of missile age production.

The special equipment in the J. W. Rex Company plant devoted to the heat treating of important components of rockets and missiles, jet engine, and nuclear power components has recently been expanded. As one of the first commercial heat treaters to enter this field, special techniques, methods of fixturing, and thorough scientific testing have been developed and applied by the company.

The additional equipment consists of a 60 in. diameter bottom opening gantry pit furnace 15 ft. long electrically fired to a maximum temperature of 1,950 F. An endothermic atmosphere is used and Minute Man and Pershing missile parts are treated, as well as rocket engine casings of various types.

Two units have also been added to the tempering facilities: one furnace of 71 in. by 15 ft., the other 60 in. by 13 ft. Both have tempering capacities of 1,650 F.

The original equipment to which the new units were added consisted of a 71 in. diameter by 22 ft. long gantry pit furnace which operated in connection with four tempering units, two of which measured 71 in. by 22 ft. Dimensions of the other units are 71 in. by 15 ft., and 71 in. by 8 ft.

The new equipment is said to make this installation the largest of its kind. It provides the capacity to handle, in addition to the missile parts and rocket engine components, such items as liquid fuel com-

ponents, nozzles, venturi tubes and jato tanks.

The hardening furnaces are supplied protective endothermic atmospheres produced by Hyen generators and have a maximum working temperature of 1,950 F. The drop bottom lids are gasketed and water jacketed for additional protection.

Carbon control is accomplished by a Rolock automatic gas analyzer and an Alnor Dew Point Controller.

Temperature in the heating zones is regulated by Leeds and Northrup strip chart recorder-controllers. The instruments maintain temperature uniformity throughout the furnaces to within 1%. Another L & N instrument—a multipoint strip-chart recorder—serves as a check on the other units.

The hardening furnaces travel above the furnace pit on a gantry. The furnace pit itself, 50 ft. long, by 10 ft. wide, by 25 ft. deep, contains the loading station, water tank and salt tank. The loading station is also suitable for forced air quenching.

Both quench tanks have a working space 5 ft. 6 in. in diameter, with a depth of 25 ft. The mar-quenching salt tank is of the nitrite-nitrate type, heated by gas radiant tubes. It provides an operating temperature of 800 F. maximum.

Furnace loads can be free-spoiled into the quench, if required, depending upon the size and shape of the part.

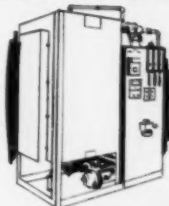


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Atmosphere Equipment
Specialist, reports . . .

GAS GENERATOR ON LINE OVER 9000 HOURS WITHOUT ELEMENT CHANGE

C. I. Hayes Type IGL-1004 Endothermic Gas Generator installed at a nationally-known mold die firm* has been operating at 1850°F on a steady cracking process for over 9000 hours without change of heating elements. Why such outstanding performance?

Rugged Construction and Good Design provide extra life insurance. A new Hayes retort assures maximum utilization of catalyst. Straight-



through retort design minimizes downtime due to catalyst change. On this installation, catalyst was changed in less than 3 hours. Original catalyst lasted 4800 hours . . . even better service is expected of the recharge.

New Delta Globar® Elements—having practically constant resistance—add extra months of service life. Elements can be connected directly across the line . . . need no tap transformers . . . are easily replaced without shutting down the generator. Here's real economy!

Wide-Range Flexibility and Precise Control are the mark of the Hayes IGL-1004. This "endo" generator can supply low or high carbon-potential atmospheres for jobs like copper brazing, annealing of steel, sintering of iron compacts, carbonitriding, etc. Wide span heating provides reserve capacity. Flexibility of temperature range—especially at higher ranges—can be utilized to the maximum . . . for maximum output at lowest dew-points without fear of burn-out. **Bulletin 5808A gives all facts on IGL-1004. Write for your copy today.**

*Name of installation on request

C. I. HAYES, INC.

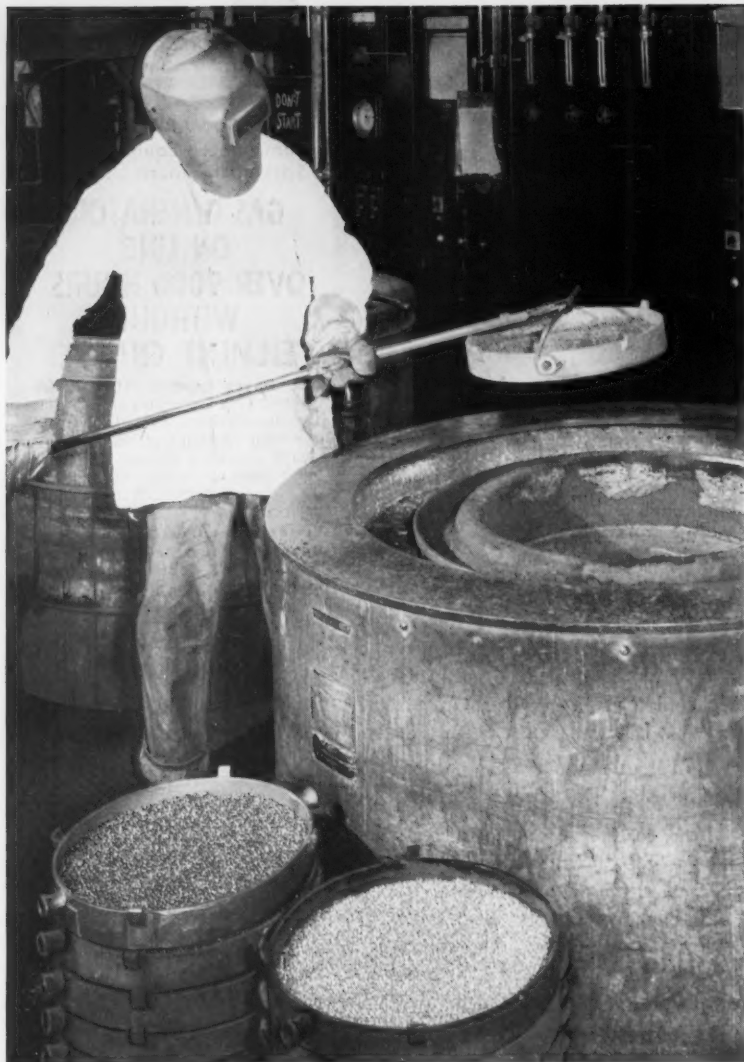
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It pays to see HAYES for metallurgical guidance, lab facilities, furnaces, atmos. generators, gas and liquid dryers.

For further information circle No. 7



Trays resist carburizing and thermal fatigue. Trays shown here are repeatedly exposed to 1650°F for 4 hours, then water quenched. Made of Type "HX" cast alloy containing 66% nickel, 17% chromium, they display excellent ability to withstand cycling without cracking or severe warping. High nickel alloys such as this are outstanding in their resistance to thermal shock and fatigue.

Under all these conditions, the appropriate nickel-containing alloys give good accounts of themselves in everything from trays and racks to tubes and retorts...from baskets and bearings to fans and fixtures.

They come feature-packed. Nickel-containing alloys provide you with heat-resisting castings having good creep strength and high resistance to scaling...thermal fatigue...thermal shock...sigma phase embrittlement.

Making your choice. Of course, the proper selection of an alloy for any specific high temperature job involves consideration of many factors, including:

- Required size and shape of the part
- Type and size of maximum load
- Speed and range of temperature cycling
- Atmospheres and contaminants
- Complexity of design
- Additional fabrication needed

You'll find lots of valuable — and usable — information on the proper selection of casting materials in our new 64-page, illustrated booklet, "Heat Resistant Castings, Corrosion Resistant Castings...Their Engineering Properties & Applications." We'll be glad to send you a copy on request. *Write for it — today.* Just ask for Bulletin A-266.

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Through day-in, day-out cycling punishment...

High nickel alloys laugh at high temperatures

Are you looking for a way to outwit thermal fatigue?

Then you'll want to know more about the reliable high temperature alloys available to you.

There are 12 basic types of nickel-chromium-iron alloys that give use-

ful strength and long life to castings subject to a wide variety of potentially destructive environments.

You name the service...temperatures ranging from 1200°F to 2200°F...reducing or oxidizing conditions...nitriding or carburizing atmospheres.

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NICKEL MAKES ALLOYS PERFORM BETTER LONGER

For further information circle No. 68

METAL TREATING



Series N **PYROTROLLER®**—temperature indicating and controlling pyrometer.
PYROTAC®—continuous temperature indication with alarm signal and shut off.

You are now looking at the NEW

Alnor®

PYROTROLLER® and PYROTAC®

(actual size)

All new—modern styling of case, designed for panel mounting and improved internal construction. But with the same time-tested Alnor movement. See next page for performance details.

Alnor®

Pyrotroller®—an electronic temperature controlling instrument that automatically controls the heat source to *maintain* a constant temperature within a set range.

Designed for temperature control on heat treating furnaces, ovens, heat sealing equipment, plastic moulding machines, cooking vessels, or any application where a precise uniform temperature must be maintained.

The Pyrotroller is a compact instrument occupying very little panel board space. The simple rugged circuitry has a minimum of components that operate well below their rated capacities. There is no shifting of the control point—no need for preselection of the one standard vacuum tube, no need for any adjustments at all on the electronic chassis.

Pyrotac®—a protective safety instrument that sounds an alarm, lights a signal light, shuts off heater circuits or fuel supply or any combination of these operations. Pyrotac protection can be added to present control systems to obtain a positive safety shut-off independent of other controls. It can also serve as the only control instrument on a process requiring complete shut down upon reaching a final preset temperature, or to notify the operator of the completion of a temperature cycle.

The Pyrotac can also be supplied for low temperature cut-out and many special applications, engineered to meet individual requirements.

The movement of these instruments is of rugged construction and includes the Alnico V magnet, hardened pivots, sapphire bearings, phosphor bronze springs and double pivoted moving coil. Both the Pyrotroller and Pyrotac have a water-proof and dust-proof case (die-cast aluminum) that protects the movement. Both can be supplied in explosion proof models.

(Attach this to your letterhead and mail)

Please send engineering information on the

☐ **PYROTROLLER®**

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COMPANY _____

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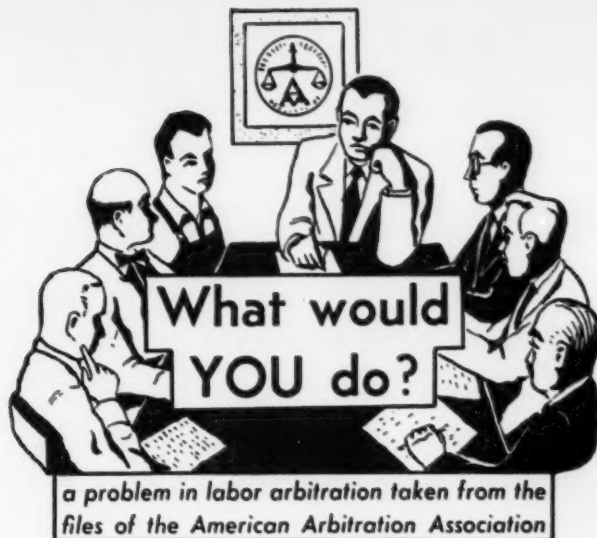
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When the loop passes between the two high frequency oscillator coils it alters their coupling thus actuating the relay.

ALNOR INSTRUMENT CO.
DIVISION OF
ILLINOIS TESTING LABORATORIES, INC.
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CASE OF THE DOUBLE STANDARD

In negotiating a contract renewal, management of a textile mill demanded a new clause establishing tighter attendance standards and providing heavier penalties for absenteeism. The company cited in particular the record of two employees who stayed out more often than they came in. The union conceded that the situation was bad and agreed to the tighter standards in exchange for other considerations.

One of the two employees was fired by the personnel manager on her next absence, which was shortly after the new contract was signed. The union demanded her reinstatement with back pay. "We admit her record is bad," said the business agent, "but that was under the old contract, before present tighter standards were established. All that counts now is absence under the new contract, and you can't fire a worker for a first offense."

The personnel manager didn't see it that way. "We specifically mentioned this employee during negotiations. That put you on notice that the new standards would apply to her. Her last absence wasn't a first offense. It was just the straw that broke the camel's back."

Finally, the case went to arbitration under the rules of the American Arbitration Association.

What Would YOU Do?

THE AWARD. The arbitrator said that inasmuch as the old contract permitted wide latitude on attendance, an employee's past record in that respect

could not be held against her. So he ordered her reinstatement, with the last absence to count against her under the new standards. On the other hand, the arbitrator could find nothing in the aggrieved employee's record of attendance to justify an award of back pay. That part of the union's claim was denied.

CASE OF THE DISPUTED VACANCY

One day in August 1959, an inspector on a sand blasting machine in a steel mill decided to transfer to another job. He had enough seniority for the move and no objection was raised. That left his job open and the union expected it would be posted and filled by moving a senior applicant up the ladder.

But management had other ideas. Things were slow anyway so they decided to leave the job unfilled; when necessary, one of the higher paid employees in the department could move over to the sand blasting machine and do the work. There wouldn't be any problem of wage adjustment because the contract permitted men to fill temporary assignments at lower-graded work provided they were paid their regular rates.

The union objected to the plan. "Some of the men have been waiting for a chance to get promoted," the chief shop steward explained. "Now that an inspector's job is vacant you have no right to refuse to fill it in the manner prescribed by the contract."

"Just because a man left a job doesn't create a vacancy," answered the personnel manager. "A vacancy

Continued on page 41

HEAT TREATERS...

Low Cost Ceiling

A low cost insulation specifically designed for use in metal shops wherever no permanent ceiling has yet been installed, has been announced by Reflectal Corporation, subsidiary of Borg-Warner Corp., Chicago, Ill. Known as Alfol aluminum foil reflective insulation, the



product does away with the need for expensive extra supports such as backer board, lath stripping and wire.

The insulation itself constitutes a handsome, maintenance-free ceiling. In many cases, an Alfol ceiling actually costs no more installed than a two-coat paint job.

Each Alfol blanket consists of aluminum foil layers that reflect 97% of all radiant heat and block heat by convection. The foil layers form reflective air spaces that hold conduction to a minimum. In addition, Alfol incorporates vapor proof backing for positive protection against condensation.

For further information circle No. 8

High-Production Furnace

A new high-production furnace for continuous bright annealing of stainless steel strip has been announced by the General Electric Company. The new furnace promises a major breakthrough in lowering the cost of annealing stainless

steel strip with improved surface appearance, corrosion resistance and physical properties of the annealed strip, according to company officials. The entire furnace concept is new—so new in fact that patents have been applied for on the furnace and several components in the furnace design, they added.

This electric furnace, designed and to be manufactured by the company's Industrial Heating Department, Shelbyville, Indiana, allows bright annealing at production rates as high or higher than existing anneal and pickle lines at approximately 50 percent lower cost per ton. Extensive tests on various types of stainless strip processed in the department's laboratory prototype furnace have shown improved corrosion resistance, appearance and physical properties over strip annealed by conventional methods. Department engineers state that the furnace is fully tested and ready for production.

The new bright annealing furnace prevents the formation of scale on the strip through the utilization of very pure and dry (-60 F. dew-point) hydrogen or dissociated ammonia atmosphere. At this dew-point, the atmosphere is 99.995% dry. Thus, the strip does not require passes through pickle baths to remove scale formed in conventional stainless steel annealing furnaces.

Vertical construction of the furnace makes possible a reduction in the amount of floor space necessary and assures that minimum tension is placed on the strip during annealing. The strip is heated and cooled during the single downward pass through the furnace, where it touches nothing but pure and dry atmosphere white at elevated temperatures. High tensions associated with horizontal catenary furnaces, which can reduce gage and width

and distort the strip, are not required.

For further information circle No. 9

Sludge Removal System

The unique side-zone sludge removal system, engineered into Kolene salt bath cleaning equipment, has made it possible to maintain continuous, uninterrupted, 24-hour cleaning, or descaling operations, with no costly shut-down time for salt pot cleaning. This feature, which has been built into numerous units in a wide range of capacities, can also be added to existing equipment, according to engineers of Kolene Corporation.



Details of this patented system, not heretofore publicized, are of unusual interest because of the overall efficiencies achieved. High-production cleaning and descaling operations, or any size installation with a heavy sludge problem, would be virtually impossible to maintain without the side sludge zone.

Success of the system is not alone due to the continuous, turbulent agitation of the bath, but to the controlled direction and rate of flow of the entire salt charge through the four inter-connected zones of the bath.

Direction and flow of the bath is engineered to specific applications. Sludge is deposited in the settling

zone, into a small pan, tightly packed, and is easily removed with no loss of production time. While one pan, filled with sludge, is removed, another is lowered into place, as uninterrupted work continues.

Salt loss during de-sludging is reduced to an absolute minimum. In stainless steel and alloy pickling operations, there is no contamination of the molten bath by carbonates or insolubles, which may contribute to unsatisfactory pickling, as well as difficult maintenance.

No sludge settles on or near the burner tubes, resulting in longer tube life. Uniform heat transfer and maximum heating efficiency are maintained throughout the entire bath.

For further information circle No. 10

Industrial Bench Oven

A temperature range to 500 F. has been incorporated into an improved forced-air, bench-type oven by Labline, Inc. The new oven is designed for industrial heating, drying, annealing and other plant and laboratory uses where controlled heating is needed.



The oven has a 4 cu. ft. working chamber, yet is only 31 in. wide, saving valuable bench space. The low-wattage heating elements are Inconel enclosed and there are no exposed resistance wires to break or corrode.

An exclusive feature is the design of the diffuser baffles which direct heated air from blower evenly across the shelves. Temperature uniformity is maintained within plus or minus 2 F. accuracy.

AUCTION

Complete Heat Treating Plant

Land, buildings and complete commercial heat treating facilities will be auctioned the week of September 15th, 1960.

For details, contact **Paul F. Ternes, President**
Standard Treating Company
Detroit 10, Michigan

The sliding stainless steel shelves are perforated to permit even air flow and are adjustable every 3 in. in height. The unit comes in scratch-proof enamel exterior or stainless steel. Overall size: 31 in. wide by 44 in. high by 23 in. deep.

For further information circle No. 11

Two New Thermocouples

Two relatively new types of thermocouples said to have been shown by scientific investigations to have "outstanding stability" in high-temperature measurements are being marketed by Brown Instruments Division of Minneapolis-Honeywell Regulator Company.

The thermocouples, rhodium-iridium/iridium and tungsten/rhenium, are usable above 3,000 F., the maximum temperature which the most resistant of conventional thermocouples can withstand.

Extensive investigations at Honeywell's Research Center at Hopkins,

Minnesota were reported by John B. Moxness, Brown Instruments market manager, to have established new values for the thermoelectric materials used in production of the thermocouples.

The rhodium-iridium/iridium thermocouple, he said, "promises to be highly useful for applications in vacuum or inert atmospheres, and particularly oxidizing atmospheres, up to 3,600 F." "This calibration," he added, "is 600 degrees beyond the practical limit for platinum-based thermocouples."

The tungsten-rhenium thermocouple, Moxness said, is "outstanding" in stability and power for applications in other than oxidizing atmospheres up to 4,000 F. and potentially to temperatures approaching 5,000 F. compared with the 2,400 F. limit for chrome-alumel thermocouples.

For further information circle No. 12
Continued on page 23

THE METAL TREATING INSTITUTE



ANNUAL ACHIEVEMENT AWARD

This year's award will be presented at the 1960 Annual ASM Awards Luncheon, and all Articles appearing in any issue of METAL TREATING from September-October 1959, to August-September 1960, or any Lectures presented at the 1959 Annual and 1960 Spring Meetings are eligible for consideration.

The award consists of the presentation of an engraved plaque and \$100.00 in cash.

AWARD COMMITTEE

Horace C. Knerr, Chairman — Publication Committee, Lloyd G. Field, Fred Heinzelman, Jr., Norman Hodgson, Michael Kober, Charles R. Weir, John R. Ries

C. E. HERINGTON — EDITOR
Metal Treating



Inspecting one of the 20-foot long stem castings at American Smelting and Refining Company plant. Cost of Ni-Vee nickel-tin-bronze, each of the stems weighs 1300 pounds.

HEAT TREATED 20-FOOT CAST ALLOY BRONZE STEMS OPERATE SLUICE GATES

Heat Treating

Case Histories

— Case No. 1

Editor's Note: A new department which will present interesting heat treating success stories.

Chicago, long known as the "Windy City," had a serious problem a few years ago. When squalls blew up on Lake Michigan, these famous winds quickly carried moisture filled air over the densely populated areas in and around the city. Then, tons of water released by flash storms quickly flooded the city's drainage system, often causing sewage to back up into Lake Michigan and thus pollute the principal source of drinking water.

Realizing that this threat to public health called for a major overhaul of the city's drainage facilities, the Metropolitan Sanitary District of Greater Chicago planned the Lockport, Illinois Power House flood control project. It was designed to increase storm water discharge along drainage routes away from Lake Michigan and to eliminate sewage back-up.

John Mohr & Sons of Chicago was responsible for engineering, fabricating and installing nine sluice gates to replace turbines. Of primary importance were the stems which would hold, open and close these gates. Unsupported along its

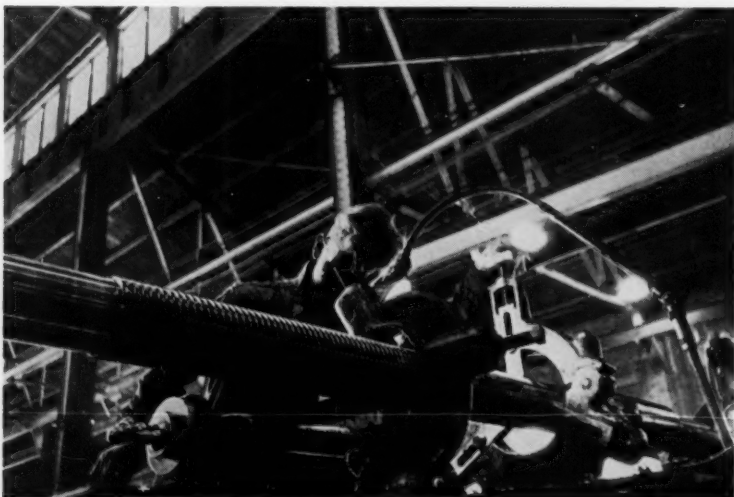
entire length, each stem would have to bear a combined torque load of 2,500 foot pounds and an axial load of 56,000 pounds.

In addition, the stems would have to withstand long periods of immersion in water of very high pH content. Since investigations had shown corrosion to be a far more frequent cause of stem failure than lack of adequate physical strength, it was essential that the material be both strong and corrosion resistant.

Various materials were considered. Manganese bronzes had the required strength characteristics, but because of their high zinc content it was thought they might be subject to dezincification in the highly alkaline waters. It was also highly desirable to select a readily machinable material.

Finally, Mohr's engineers turned their attention to one of the Ni-Vee bronzes, developed by The International Nickel Company. The alloy selected contained only 2% zinc and was consequently not subject to dezincification. With heat treatment, it could be brought up to the required strength.

Because the bronze rods were to be precision-cast, in an exclusive continuous casting process by American Smelting and Refining Company (Asarco), such fine tolerances could be guaranteed that the need to machine the stems before



Machining threads on a Ni-Vee bronze stem for use on Chicago flood control sluice gates.

threading them was eliminated. They could be cast to exact outside diameter specifications.

The rods were cast and cut to 20 foot lengths at Asarco's plant in Perth Amboy, New Jersey. They were heat treated at Benedict-Miller Company, Lyndhurst, New Jersey, one of the few companies with furnaces large enough to accommodate the long units. Each rod was heated to a uniform temperature of 1400 F. for eight hours, quenched in oil, after which they were easily straightened on a Medart machine between contra-angled convex and concave rollers.

The rods were then aged at 600 F. for about 16 hours and slowly air cooled. After the hardening treatment they were subjected to a final straightening in a hydraulic press. When finished, the stems were aligned to 1/16th in. of true per 5 ft. segment, and 1/4 in. in the full 20 ft. length.

The Ni-Vee bronze alloy used in the stems is of special high purity composition and contains 88% copper, 5% tin, 5% nickel, 2% zinc and a maximum of 0.01% lead. After heat treatment the stems had a yield strength upward of 69,000 psi, ultimate tensile strengths ranging from 75,000-90,000 psi, elongation 6% to 9% and an average Brinell hardness of 250.

This was the first time that continuous casting of Ni-Vee bronze to such length and diameter had been attempted. As a result of the process, the stems for the Lockport project have a uniformly fine grain microstructure as well as freedom from porosity and dross inclusions. Heat treatment assures high strength and exceptional resistance to wear and corrosion.

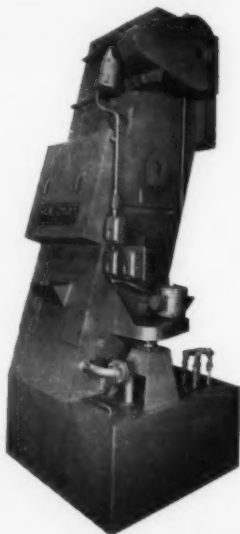
The solution worked out for Chicago has vast implications for other metropolitan areas which border large bodies of water. More important, it graphically illustrated how a combination of engineering and manufacturing skill can alleviate what could be a potentially dangerous health situation. • • •

NEWS TO HEAT TREATERS

Continued from page 21

Parts Washing Machine

This Ransohoff vertical conveyor-type washing machine, designed for the inter-process cleaning of small stamped and forged parts, washes a 300 to 1,500 lb. work load each hour. With its 11 ft. vertical conveyor, only 16 sq. ft. of floor space is required. A conventional washer of this capacity requires 44 sq. ft. of floor space.



A separate conveyor carries the work to the charging hopper. Parts are received a few feet above floor level and are given a thorough spray cleaning as they are conveyed upward to the end of the conveyor where parts are automatically discharged. Parts are discharged at or near ceiling level or the conveyor may be extended to discharge the work on the floor above, thereby eliminating handling costs.

The unit is complete with conveyor assembly, pump, motors and switches.

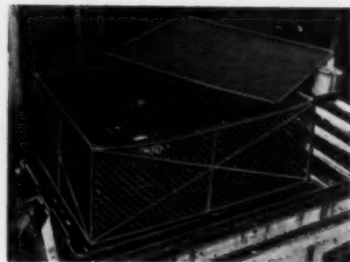
For further information circle No. 13

Wiretex Basket Feature

A new parts-holding fixture fabricated by Wiretex Manufacturing Company, Bridgeport, Conn., brings

greater efficiency to heat or chemical treating of small parts.

Available in Type 330, Inconel,



Monel and other alloys, the new basket is made to meet any type of treating operation. The No. 2 mesh is fine enough to prevent parts drop-out and dividers are available when separation of parts is desired.

Baskets are 32½ in. by 24 in. by 12 in. and have ½ in. rod supported framework. Mesh wire is .120 diameter. Wiretex engineers report users are successfully loading 500 pounds into the fixture which also shows resistance to high temperatures and corrosion exceeding that of previously used equipment.

Baskets may be used in pusher-type installations or may be fitted with handles for pit type furnaces and other operations in which handling is required.

For further information circle No. 14

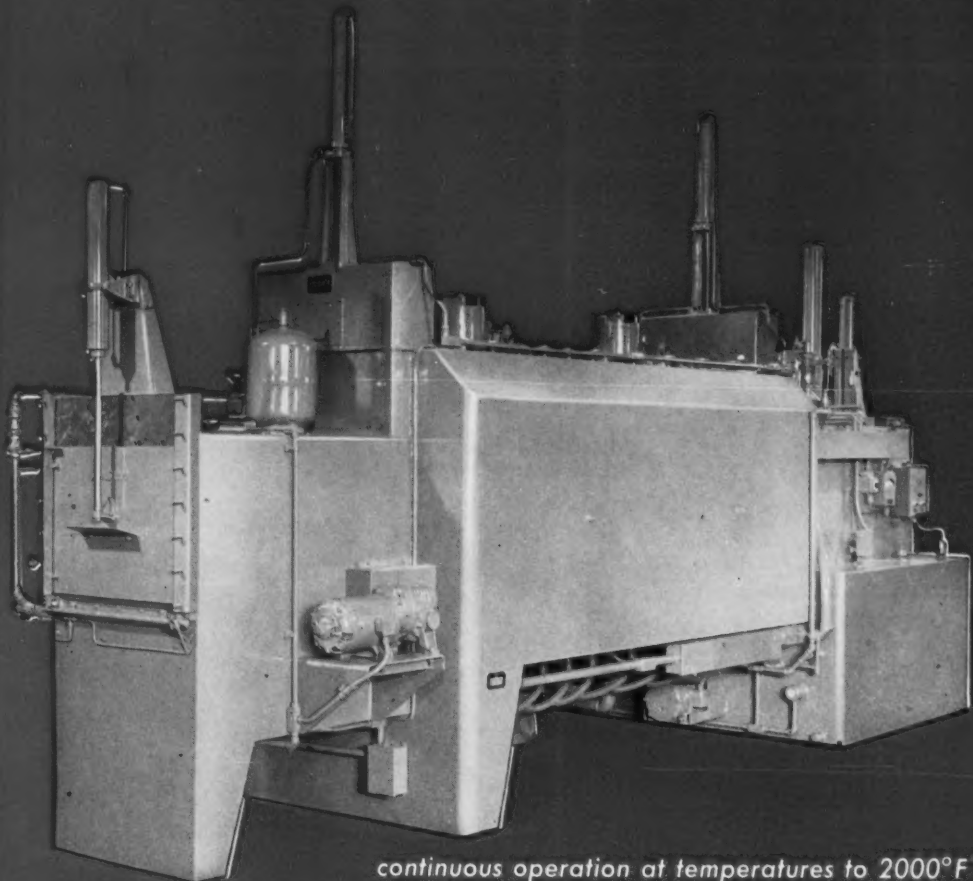
New Linde Plant

A new plant to serve East Coast industry with Linde's Flame-Plating process will be built at North Haven, Connecticut, it has been announced by W. B. Nicholson, President of Linde Company, Division of Union Carbide Corporation. Completion is scheduled for December, 1960.

"The demand for Flame-plating services has increased so rapidly," H. V. Mosby, sales manager, Flame-Plating, said, "that we have undertaken a long range expansion program in order to give better service to the many industries using it. The North Haven plant is the third step in our expansion program, and is being built primarily to serve industries in New England and the Central Atlantic states." Mosby added,

Continued on page 25

Here's the NEW Ipsen pusher heat treating unit



*continuous operation at temperatures to 2000°F**

Meets precise metallurgical standards in carburizing, carbonitriding, neutral hardening, sintering, normalizing, annealing and brazing.

- Each zone with individual 100% forced convection heating!
- Silicon carbide skid-type hearth fully supports lightweight trays.
- Super-alloyed ceramic tubes guaranteed one year. Ipsen "Flame-Busters" complete combustion within the heating portion of the tube.

- Both forced convection atmosphere cooling and hot-oil quench.
- Ipsen pusher units are shipped completely piped, wired, and tested.

Cross-section diagrams and complete details covering all sizes of Ipsen pusher units are shown in Bulletin P-59. Send for your copy, today.

*special units available for higher temperature operation



IPSEN INDUSTRIES, INC. • 733 SOUTH MAIN STREET • ROCKFORD, ILLINOIS

For further information circle No. 15

NEWS TO HEAT TREATERS

Continued from page 23

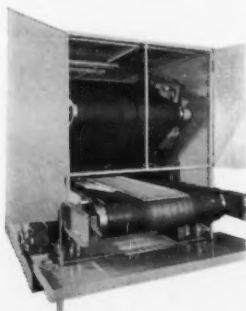
"the new plant has been planned so that production can be expanded at a later date to meet the further increases in demand that we expect."

Flame-plating, introduced in 1953, is Linde's process in which coatings of hard materials, such as tungsten carbide and aluminum oxide, are applied to parts made from a variety of base metals and other materials, providing them with far greater resistance to wear, abrasion, erosion and corrosion.

For further information circle No. 16

Conveyorized Grinder

Thickness tolerances of $\pm .001$ in. can be held on a new conveyorized, abrasive belt grinding machine with diamond-shaped head that flexes the belt as it drives. The machine, manufactured by Mattison Machine Works, Rockford, Illinois, is now being used in the aircraft industry for high production grinding of honeycomb.



Unusually accurate for an abrasive belt machine, the Mattison No. 458 is ideally suited for finishing honeycomb, sheet stock, small parts such as motor laminations, and similar high production flat work requiring critical thickness tolerances.

Positive grain penetration is achieved through a combination of high horsepower on the belt drive and the diamond head design. Four rollers in the diamond-shaped head continuously flex the abrasive belt to keep it clean, cool, and free-cutting.

Continued on page 29

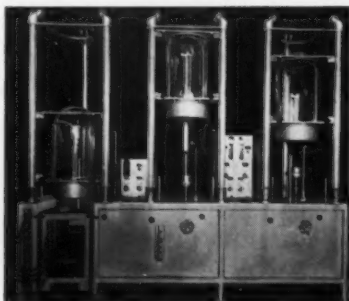
Use of four rolls avoids wrapping of the belt on the contact roll. The resultant flat angle of attack permits the belt to conform more closely to the uneven surfaces of the sheet.

For further information circle No. 17

Lepel Brazing Fixture

Lepel High Frequency Laboratories has developed a line of production fixtures to braze metal assemblies under a controlled atmosphere by induction heating.

The reducing atmosphere prevents oxidation on the work during heating, eliminating the need for flux. The joints produced with these units are uniformly sound and free of residual or entrapped flux. This type of joint is essential in numerous assemblies to insure dependable corrosion-resistance and strength in critically stressed inaccessible parts. Such joints are impossible to achieve with normal brazing techniques. Combining induction heating, which provides rapid highly localized heating, and a controlled atmosphere, these units have proven themselves in joining copper alloys, steel and stainless steel assemblies on a production basis.



Shown here, there are two fixed working stations and one castor-mounted heating station which can be quickly unlatched, water cooling lines unplugged from the main bench and with the bell jar raised, the whole assembly is rolled out. Another heating station with a new assembly is rolled in, hooked up and ready for heating so that a minimum of operator time is lost.



High alloy such as RA-330, Hastelloy and Inconel—for the heat treating industries... a plant with over 50 years experience as fabricators, and grey iron castings. Illustrated above is Venturi-High Temperature Alloy.

Alloy muffle
... example
of one type
fabrication
job.



Corrugated
baskets.



Pickling
racks.



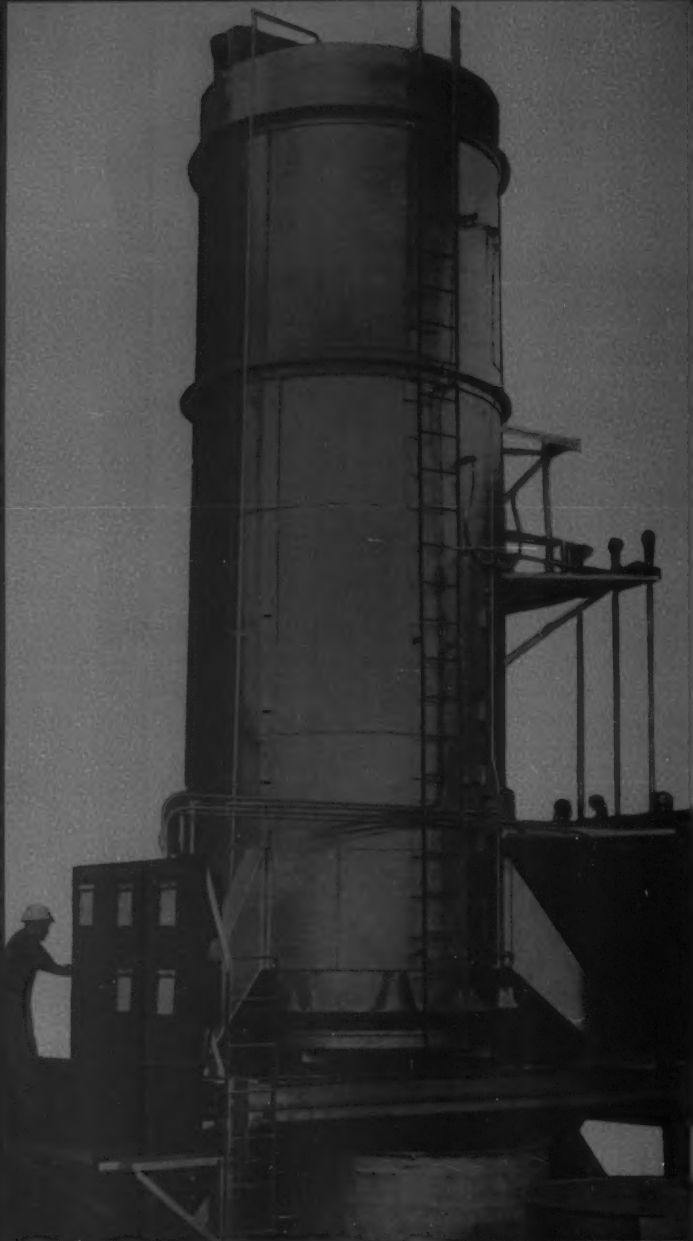
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For further information circle No. 18



HAVE YOU A HEAT TREATING PROBLEM?

*Take it to your Commercial
Heat Treater for:*

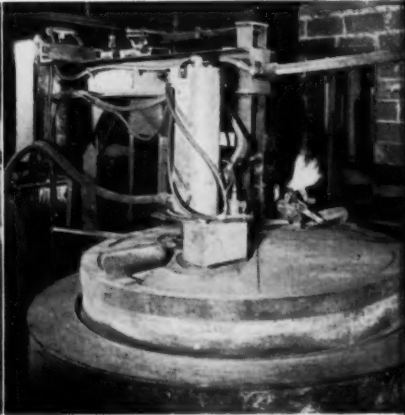
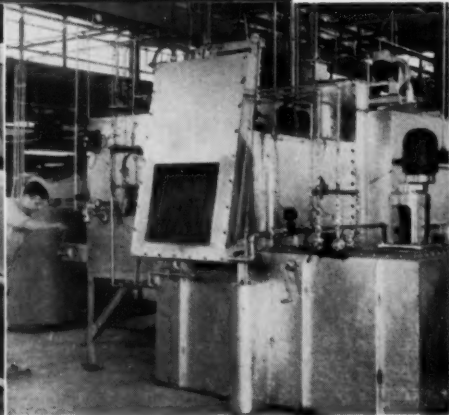
DESIGN: Technical advice about the *design* of metal parts requiring heat treating.

PROCESS: Facts as to the correct heat treating *process* required to achieve service requirements.

EQUIPMENT: The variety of modern specialized *equipment* needed for efficient cost saving operations.

SKILLS: The operational *skills* developed by years experience in all phases of ferrous and non-ferrous metal treatments.

*All these add up to SERVICE
—the type of service only the
Commercial Heat Treater
can provide.*



THERE'S A HEAT TREATING SPECIALIST NEAR YOUR PLANT

ALABAMA

Southern Metal Treating Co., Inc.
3131 10th Ave. N., Birmingham 4

CALIFORNIA

Downey Steel Treating Co., Inc.
9637 Nance St., Downey
National Heat Treating Co., Inc.
1833 W. Florence, Inglewood 1
Certified Steel Treating Co.
2454 E. 58th St., Los Angeles 58
Lindberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23
Cook Induction Heating Co.
4925 East Slauson Ave., Maywood

CONNECTICUT

Commercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6
Stanley P. Rockwell Co.
296 Homestead Ave., Hartford 12
Ireland Heat Treating Co.
512 Boston Post Road, Orange

ILLINOIS

Accurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12
Allied Metal Treating Corp. of Illinois
333 N. California Ave., Chicago 12
Dura-Hard Steel Treating Co.
2112 W. Rice Street, Chicago 22
Perfection Tool & Metal Heat Treating Co.
1756 West Hubbard St., Chicago 22
Fred A. Snow Co.
1942 West Kinzie St., Chicago 22
American Steel Treating Co.
P. O. Box 396, Crystal Lake
Lindberg Steel Treating Co.
1975 N. Ruby St., Melrose Park
Eklund Metal Treating, Inc.
721 Beacon St., Rockford
Scott Ford, Inc.
2719 Fifth St., Rock Island
Ipsenlab of Rockford, Inc.
2125 Kishwaukee Street, Rockford
O. T. Muehlemaier Heat Treating Co.
1500 Preston St., Rockford

INDIANA

Quality Steel Treating Company
1630 Locust Street, Anderson
Industrial Heat Treating & Metallurgical Co., Inc.
2131 Northwestern Ave., Indianapolis 2

MASSACHUSETTS

Kinetics Corporation
2 Churchill Road, Hingham
Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43
New England Metallurgical Corp.
475 Dorchester Ave., South Boston 27
Springfield Heat Treating Corp.
99 Margaret Street, Springfield
Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Anderson Steel Treating Co.
1033 Mt. Elliot Avenue, Detroit 7
Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28
Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4
Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8
Vincent Steel Process
2424 Bellevue Ave., Detroit 7
State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8
Royal Oak Heat Treat, Inc.
21419 Dequindre, Hazel Park

MISSOURI

Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15
Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

American Metal Treatment Co.
Spring and Lafayette Sts., Elizabeth
Benedict-Miller, Inc.
Marin Ave. & Orient Way, Lyndhurst
Bennett Heat Treating Co., Inc.
246 Raymond Boulevard, Newark 5
L-R Metal Treating Corp.
107 Vesey St., Newark 5
Temperature Processing Co., Inc.
228 River Road, North Arlington

NEW YORK

Owego Heat Treat, Inc.
Rural Route 1, Apalachin
Eastern Heat Treating & Brazing Corp.
44 Sea Cliff Avenue, Glen Cove
Fred Heinzelman & Sons, Inc.
138 Spring St., New York 12
Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38
Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11
Rochester Steel Treating Works
962 Main Street, E. Rochester 5
General Heat Treating Corporation
206 Sand Street, Syracuse 3
Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 11
Ferrotherm Co.
1861 E. 65th St., Cleveland 3
Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14
The Modern Steel Treating Co.
5466 Lake Court, Cleveland 14
George H. Porter Steel Treating Co.
1273 East 55th Street, Cleveland 3
Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14

OHIO — (Cont'd)

Winton Heat Treating Co.
20003 Lake Road, Cleveland 16
Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3
Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Drever Company
Red Lion Rd. & Philmont Ave.,
Bethayres
Robert Wooler Company
Dresher
Wiedemann Machine Co.
Gulph Road, King of Prussia
J. W. Rex Co.
Eighth and Franconia Avenue,
Lansdale
Lorenz & Son
1351 N. Front St., Philadelphia 22
Metlab Company
1000 E. Mermaid Lane, Philadelphia 18
Pittsburgh Commercial Heat Treating Co.
49th St., and A.V.R.R., Pittsburgh 1
Pittsburgh Metal Processing Co., Inc.
1850 Chapman Street, Pittsburgh 15

TENNESSEE

Mid-South Metal Treating Co.
463 Scott St., Memphis 12

TEXAS

Dominy Heat Treating Corp.
P. O. Box 5054, Dallas
Superior Heat Treating Co., Inc.
P. O. Box 69, Fort Worth 1
United Heat Treating Company
2005 Montgomery Street, Fort Worth 7
Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11
Houston Heat Treating Company, Inc.
2100 Quiltman Street, Houston 26
Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

WISCONSIN

Allied Metal Treating Corp.
P. O. Box 612, Milwaukee 1
Heat Treating Engineers, Inc.
1146 North 54th St., Milwaukee 8
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14
Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4
Wisconsin Steel Treating & Blasting Co.
1114 South 41st Street, Milwaukee 15
Harris Metals Treating Co.
4100 Douglas Ave., Racine

CANADA

Ipsenlab of Canada Limited
27 Bermondsey Road, Toronto 16, Ont.

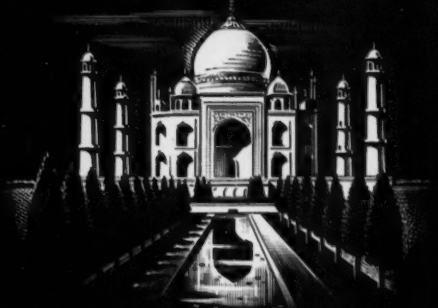
For further information circle No. 19

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quenching equipment
operates . . .



Other outstanding Shell
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AN INTERESTING FACT!

Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the Voluta musica.

Shell Voluta Oil is there

Around the world, Shell Voluta Oil is available—under the same brand name and providing the same outstanding quenching oil effectiveness. This is assurance that your customers abroad will enjoy the same performance from your heat-treating equipment that domestic customers rely upon.

Voluta® Oil is a stable, high-speed quenching oil that proves ideal in both static and circulating quenching systems.

It offers two unique characteristics: (1) It remains stable at temperatures up to 180°F with no appreciable sludge formation. (2) It permits safe, rapid quenching of parts which ordinarily have a tendency to become distorted.

No matter where your quenching equipment is shipped, make Shell Voluta Oil your standard recommendation. Write for complete information.

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505 UNIVERSITY AVENUE TORONTO 2, ONTARIO



NEWS TO HEAT TREATERS

Continued from page 25

One of the outstanding features of this unit is the rapid changeover from the one job to another.

For further information circle No. 21

Steel Drum Dumper

Conveyors and Dumpers, Inc., Division of Mercury Industries, Hillsdale, New Jersey has announced the Cesco Steel Drum Dumper, a unit which virtually brings automation to the handling of steel drums. This dumper line is designed to operate at lifting heights from 12 in. up to 50 ft., emptying its contents into mixers, tanks, tumblers, chutes, conveyors, hoppers etc.



Manual labor is kept to a minimum and, with the added factors of easy loading, speedy dumping, and reduced job accidents, it means appreciable savings.

Rated capacities are from 100 lb. to 5,000 lb., dependent upon unit selected. The Cesco Dumper handles powders, granulars, stampings, castings, scrap, and liquid of heavy viscosity. Free flowing liquids are not feasible due to splash-back.

For further information circle No. 22

Intricate Rasp Blade

The skill of a Louisville, Kentucky, commercial heat treating company has helped make possible

the successful production in the United States of an intricate rasp blade originally produced exclusively in Europe.

The company, Louisville Metal Treating Service, was assigned the job of carbonitriding the rasp blade by its United States manufacturer, American Saw & Tool Company. The blade cuts steel by the action of minute cutting edges on its vanes. The vanes require careful handling to prevent destruction of their edges.

Tough jobs tend to be routine at Louisville Metal Treating. They heat treat parts weighing from 1/4 oz.

to 500 lbs., including high speed steel, and bearings of powdered metal, the dimensions of which must be held within .002 or .003 in. And they do it under the "moment's notice" conditions met by most commercial heat treating houses—where lengthy trial and error experimentation is another way of committing corporate suicide.

According to A. V. Mudd, Superintendent, two important factors in the success of Louisville Metal Treating are an absolutely reliable

Continued on page 31

PSC
fabricated alloy
**FURNACE TUBES
& RETORTS**
Save You Money

And PSC furnace tubes, for example, often double the service life of cast tubes. As one of the leading suppliers of fabricated heat-treat units, PSC also furnishes boxes, baskets, pots, trays; any size, style.

Save with PSC All-Sheet Equipment

THE PRESSED STEEL CO.
Wilkes-Barre, Pa.

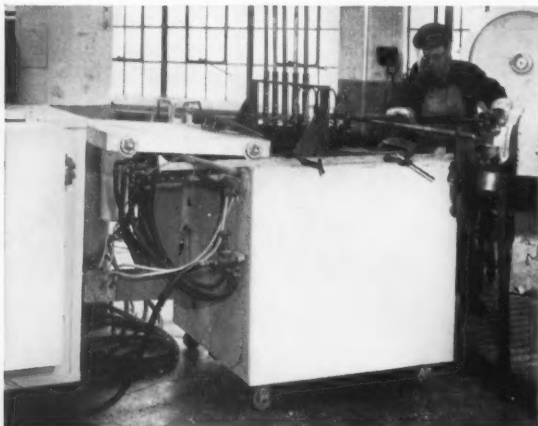
For further information circle No. 23

Heat-treating problem?

Profit from the experience of these users

Each of these users had a heat-treating problem. Their problems were different, yet they all took the same first step toward a successful solution. They consulted a Hevi-Duty Sales Engineer . . . wisely.

A Hevi-Duty Sales Engineer is a specialist. He is qualified to recommend equipment for an entire heat processing system — does it nearly every day. And when it comes to specifying equipment, he has no ax to grind. He doesn't have to push any special size or type. Hevi-Duty makes them all — electric or fuel-fired, all sizes, all temperatures. And if none of these fit exactly, Hevi-Duty will quickly adapt or design a unit that will.



If you have a heat-treating problem, be sure to call in a Hevi-Duty Sales Engineer. He'll be glad to come in without obligation and you will probably profit from his recommendations.

HEVI-DUTY

*Electric and Fuel-Fired
Industrial Furnaces and Ovens*

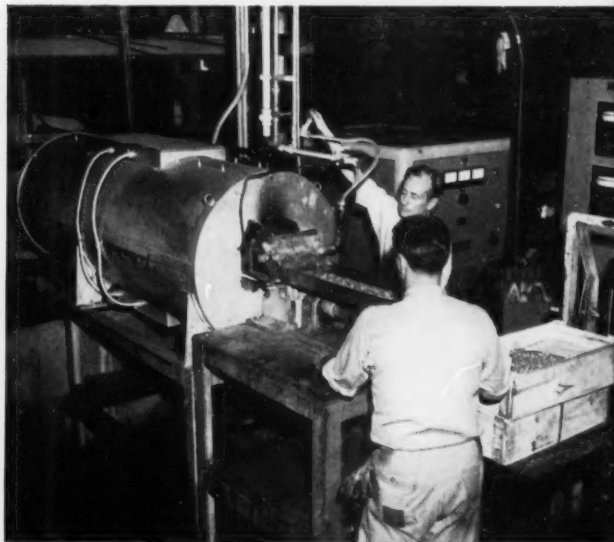


A Division of
Basic Products
Corporation

Hevi-Duty Electric Company, Milwaukee 1, Wis.

▶ This immersed electrode salt bath furnace is used at Clevite Research Center, Cleveland. It has a steel pot for low temperatures and a ceramic pot for temperatures up to 2300°F. The furnace is mounted on casters and coupled with a transformer so that it may be used for experimental work anywhere in the shop. *Please write for Bulletin 655.*

For further information circle No. 24

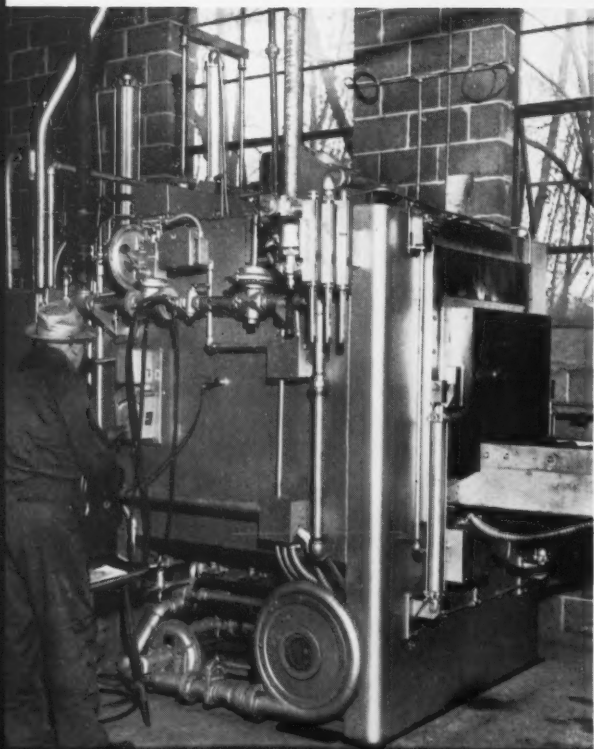


▲ This Hevi-Duty Shaker Hearth Furnace proved to be the profitable answer for Fred Heinzelman & Sons, a New York City commercial heat treater. Small parts are fed onto the hearth and progress through heat and quench cycles automatically. Switching to a shaker eliminated jig and wire time and increased production from 20 to 60 pounds an hour. In addition, the uniform quality of the work has eliminated rejects. *Please write for Bulletin 1057.*

For further information circle No. 25

▶ Ken Ireland, Ireland Heat Treating Company, Orange, Conn., reports a 50 percent reduction in operating costs since switching to this Hevi-Duty Gas-Fired Clean-Line Automatic Heat Treat Unit. One of its jobs is hardening 410 stainless steel knife blades. Knives come out straighter and brighter, with a more consistent hardness than previously achieved. *For information request Bulletin D-100.*

For further information circle No. 26



NEWS TO HEAT TREATERS

Continued from page 29

quenching medium and good equipment.

"We used to have two quenching oils—a fast quench for the Ipsen furnace and a slower quench for our open tank," says Mr. Mudd. "Now we quench everything in Gulf Super-Quench."

Combining superior initial quenching power through the hardening range with slow cooling in the final or distortion ranges, Gulf Super-Quench was considered to be a major factor in successful carbonitriding of the rasp blades.

Specifically, the company was required to put a .0055 in. case, plus or minus .0015 in., on the special steel blades. As-quenched inspection showed that quenching from 1500 F. in the Ipsen T-400 controlled atmosphere furnace achieved the required depth of hardness, and uniformity well within the required hardness range.



"It has been considered difficult to obtain consistent bright hardening," added Mr. Mudd, "but we're getting clean surfaces on the rasp blades with Gulf Super-Quench and the proper atmosphere."

For further information circle No. 27

King-Size Tote Box

Shown on page 32 is a linear polyethylene tote box of unusual size and depth which has been developed by Patti Plastics Corp., Newark, New Jersey. The box measures (I.D.) 26¾ in. by 25 in.

Continued on page 32



....tough on retorts

2100° F VACUUM BRAZING

demands
Exacting
Fabrication



This 8-foot-high bell retort fabricated of ¼-in. RA 330 stainless by Alloy Engineering is used for equalized vacuum brazing in an electric refractory furnace. Designed for 2100° service at a 4 micron/1000 micron equalized vacuum, the retort is subject to cyclic thermal stresses reflected by a 1-in. increase in diameter at operating temperature.

The upper cylinder, 4 feet in diameter, tapers to 6½ feet at the bell base where it is joined to the 1¾-in. mild-steel base ring grooved top and bottom for O-ring vacuum seals.

Alloy's experience with performance factors of high temperature equipment enables it to assist in engineering with recommendations as to construction, type and gauge of material. Careful fabrication, preparation and welding enables Alloy to produce retorts, muffles, and fixtures for trouble-free high-temperature service.

Rely on Alloy's experience and facilities to help solve your heat treating problems.

Write today!

continuous carburizing furnace BASKET



Designed by Alloy or fabricated to your specs.; trays and fixtures for economical service.

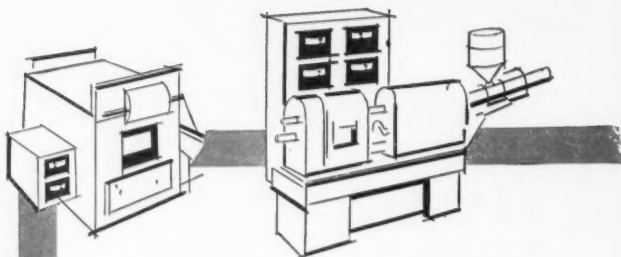
2100° hydrogen atmosphere sintering MUFFLE



Custom engineered and fabricated to your service needs.

THE **ALLOY** ENGINEERING COMPANY
70 Sheldon Road / Berea, Ohio

Why it pays to see that
WEST Instruments are in
Original Equipment
 using Temperature Control



Makers say

"Our equipment sells best on performance, including ease of operation and maintenance. We can't risk dissatisfaction that stems from components, such as instruments. We're safer with Gardsman, by West, and their world-wide service."

Users say

"Instrumentation can be the key to overall efficiency of major equipment. West temperature controllers work better than most, definitely save on several counts . . . including initial cost. It pays to specify."



Whatever type of control—off-on, proportioning, high-limit, stepless, program—get the best: get West. *Tubeless*. Compact. Reliable. Ask your West representative or write for Bulletin COM.



4357AA W. MONTROSE, CHICAGO 41, ILL.

British Subsidiary:
 WEST INSTRUMENT LTD.,
 52 Regent St., Brighton 1, Sussex
 Represented in Canada by Davis Automatic Controls, Ltd.

the trend is to WEST



For further information circle No. 29

NEWS TO HEAT TREATERS

Continued from page 31

by 12 in. deep and stacks 11 in. It weighs less than 10 lbs., will hold over 300 lbs., and is chemically resistant to acids, alkalies, oils, as well as a number of other liquids.

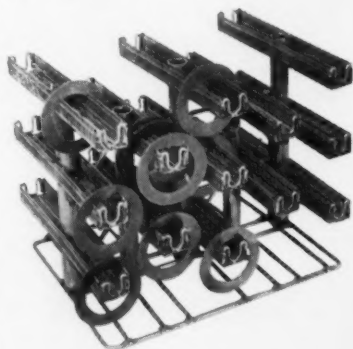


Linear polyethylene is ideal for degreasing and washing operations and maintains its characteristics at temperatures below zero and up to 250 F. It will not rust, splinter or corrode and it will protect critical surfaces during production, shipping and handling.

For further information circle No. 30


Parts Holding Fixture

A new parts holding fixture, designed especially for ring shaped objects, is available from Wiretex Manufacturing Co., Inc., Bridgeport, Conn.



Originally developed for clutch plates, the fixture may be used with most surface furnaces. Made entirely of Inconel, it has slotted holders, arranged in staggered tiers, to hold a workload as heavy as 400 lbs. Holders are supported by

Continued on page 35



Applications:

firing of titanates, ferrites, grinding wheels, dinnerware and tile...hardening of steel saws, drills, etc...heat treating of high speed steel...bright cleaning metals...sintering...calcining...refining...melting of glass and metals...many laboratory applications.

Perform brilliantly!

Norton CRYSTOLON* "Hot Rods" consistently outlast other types of non-metal electric heating elements... both in intermittent and continuous operation... in furnaces and kilns. They require less frequent changing and fewer changes in voltage taps. One-piece, non-welded "Hot Rods" are straight and strong... provide unmatched heating uniformity, electrically, efficiently, economically. Standard sizes readily available. Send for booklet: "Norton Heating Elements." NORTON COMPANY, 627 New Bond Street, Worcester 6, Mass.

*Trade-mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON
REFRACTORIES

Engineered... R_x ... Prescribed

75 years of... Making better products... to make your products better

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — **DEHRMANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

For further information circle No. 31

About People.....

Crucible Ad Manager

Mrs. Josephine M. Shea has been appointed manager of advertising for Crucible Steel Company of America.

As Crucible's assistant manager of advertising, Mrs. Shea has received wide recognition for her professional abilities. She is considered one of the outstanding women in the advertising field and her vast knowledge ideally qualifies her for new responsibilities with Crucible. This is probably the first time in the history of the steel industry that a woman has served as manager of advertising.

Mrs. Shea joined Crucible in 1946 and was named assistant manager of advertising in 1953.



Josephine M.
Shea

A native of Suffern, New York, she was graduated from Skidmore College in 1934 with a B.A. degree. She also did graduate work in English, accounting, and cost accounting at Columbia University, Pace Institute, and Long Island College.

Mrs. Shea is a Board Member of the Altrusa International and the Girl Scouts of Allegheny County; vice president and member of the board of directors of the Pittsburgh Advertising Club and vice president of Skidmore College Club of Pittsburgh, and a member of the Association of Pittsburgh Business Women's Clubs and the International Advertising Association.

Alloy Steel Manager

U.N. Alloy Steel Corporation has just announced the appointment of Richard L. Duncan as product manager of the company's hot work tool steel division.

Duncan comes to his new post with a background of 15 years experience as an extrusion tool engineer. He will direct metallurgical research and development of new alloys as well as tooling engineering services for the extrusion industry.

Sunbeam Chief Engineer

Willard Roth has been appointed assistant chief engineer for industrial furnaces and equipment by Sunbeam Equipment Corporation, Meadville, Pennsylvania. He was formerly manager of engineering for the industrial division of Lindberg Engineering Company.



Willard
Roth

The appointment of Roth is another step in Sunbeam Equipment Corporation's program of more complete service on an industry wide scale.

To New Carpenter Post

Gerald R. Garinger, formerly assistant branch manager for The Carpenter Steel Company, in Toledo, Ohio, has been promoted to

branch manager, Indianapolis, Indiana.

In his new position Garinger will be responsible for warehouse management and for mill and warehouse sales involving 115 counties



Gerald R.
Garinger

in the states of Indiana, Illinois, and Kentucky.

Prior to his Toledo assignment, Garinger was a Carpenter salesman. He is a graduate of Northwestern University and a member of the American Society of Tool Engineers and the American Society for Metals.

D & A Sales Engineer

Walter Anderson, President of The Denton and Anderson Corporation, a national sales organization, recently announced the appointment of Robert J. Songer as sales engineer, in the Chicago territory. Songer has just completed a training course in heat treating and its applications at the factory of Induction Heating Corporation, Brooklyn, New York.

Before joining the staff of The Denton and Anderson Corporation, who are direct representatives for Induction Heating Corporation, Songer had been affiliated with the Sonneborn Company of Detroit.

He attended the University of Michigan and holds a B.S. degree in Industrial & Mechanical Engineering. Robert is a member of the

National Society of Professional Engineers, AIEE.

Bauscher Joins Lee Wilson as V-P

J. A. Bauscher has joined the Lee Wilson Engineering Company, Inc. as vice-president in charge of research. The move was announced by Lee Wilson's president, Floyd Olmstead.

"The appointment of Bauscher is another step in our continuing program to build and maintain the finest research and development laboratory in the metal annealing equipment industry," stated Olmstead.



J. A.
Bauscher

Bauscher comes to Lee Wilson from the United States Steel Corporation where he was chief of the sheet products division of the applied research laboratory. In this capacity he directed research and product development activities on tin plate, coated sheets, enameling steels, electrical sheets, drawing-quality steels and stainless steels.

Management Consultant

W. C. Potthoff, well known in the field of ultrasonics, has announced that he is entering the management consulting field with offices located in West Chester, Pennsylvania. Potthoff, a mechanical engineer by training, has an extensive knowledge of industrial management.

Mr. Potthoff has had many management and engineering assign-

Continued on page 42

NEWS TO HEAT TREATERS

Continued from page 32

1 1/4 in. posts supported, in turn, by a base frame made with 3/8 in. diameter rods. Holders are fitted with 1/8 in. thick U-rods that prevent parts from falling during handling and transfer.

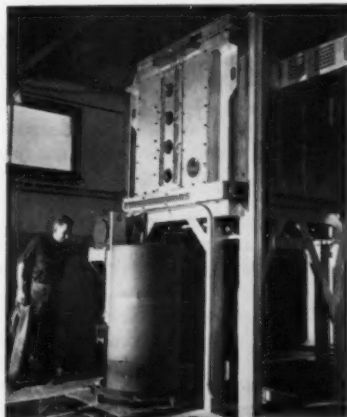
The entire unit stands 26 1/4 in. by 17 1/4 in. by 17 1/4 in. high. It is being used in heat treating procedures involving temperatures as high as 2,100 F. and is made to withstand severe thermal shock during quenching.

Similar units are available in sizes to meet specific needs and may also be ordered in a wide range of standard alloys for heat and chemical treating.

For further information circle No. 32

Improved Harper Line

Harper Electric Furnace Corporation, Buffalo, New York has updated and expanded its line of Elevator Furnaces equipped with neoprene sealed retorts. Thirty-two models, with load heights from 12 in. to 66 in. and inside retort diameters from 12 in. to 48 in., are now available for processing a wide variety of metals at temperatures up to 2,300 F.



Low dew points can be maintained for critical brazing, annealing, hardening and sintering operations.

Loads can be heavy or light, cylindrical or rectangular—any shape or size. With the work en-

closed inside the sheet alloy retort, atmosphere gases are circulated through the load entering and leaving the car via flexible hoses. A water cooled neoprene seal keeps gas from escaping and a built in hoist, operated by push button control, eliminates the need for cranes.

Time temperature cycles can be duplicated or varied in accordance with work requirements. With heating elements surrounding the retort and multiple-zone control provided, a high degree of temperature uniformity is attained throughout the load.

All models in the line can be furnished with air blast coolers, extra elevator cars and retorts, gas flow control panels, automatic programming controls, and provisions for load thermocouples.

For further information circle No. 33

Building Block Concept

A new building block concept consisting of a portable monitor control panel mounted on a portable heating station has been announced



by Cincinnati Milling Machine Company. Operation of the unit consists of a scanning mechanism which is used to spin progress the part vertically through the heating coil of the heating station. Power is furnished by a motor driven, vertical generator. The modular design of the unit permits transfer from one production line to another as well as furnishing a compact design which saves valuable floor space.

Continued on page 37



Corrugated Inconel hood is 3'3" wide, 6'8-5/16" long, and 3' high. In service at Metallurgical Processing Corp., 180 Michael Drive, Syosset, N. Y. — this Inconel hood is used for general heat treating at temperatures as high as 2000°F.

How well does Inconel equipment perform?

After 250 cycles (15 hours each, 1900°F)... Inconel hood still good for high temperature brazing

After serving 3,750 hours at 1900°F, this hood of Inconel® nickel-chromium alloy is now being used for general heat treating at temperatures as high as 2000°F. It's in continuous service in brazing and annealing, using dissociated ammonia, pure hydrogen, and nitrogen atmospheres.

Fabricated by Rolock, Inc., Fairfield, Conn., of lightweight Inconel corrugated sheet for Metallurgical Processing Corp., 180 Michael Drive, Syosset, N. Y. — this hood is living up to the reputation of long life and low maintenance earned year after year by Inconel alloy.

Why Inconel lasts longer

There are two principal reasons why Inconel alloy equipment lasts so much

longer under severe service conditions. Inconel alloy provides high-temperature strength and resistance to common heat-treating atmospheres to give your fixtures built-in longevity. And its excellent forming and welding properties permit you to use any practical design to add even more hours to equipment life.

What's more, the high strength of Inconel alloy permits you to use light-fabricated, easier-to-handle equipment to do the job of costly "heavyweights" in high temperature service. This gives an important boost to operating efficiency and economy.

You'll find Inconel alloy delivers the properties and performance you want

in heat-treating equipment. In your hoods, or your heating and quenching baskets, your brazing trays and carriers, or conveyor belts. For your carburizing or nitriding service. Or for whatever process you're working with.

If high temperatures are pushing your operating costs up right now you can do two things about it. First, write us for a copy of "Keeping Operating Costs Down When Temperatures Go Up." This gives you the complete Inconel story. Second, get expert help in your material selection problems by writing to:

*Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia

INCONEL®

NEWS TO HEAT TREATERS

Continued from page 35

The scanning unit includes a limit switch control of heating and quench cycles and preset feed rates. Chrome plated guide rods assure smooth operations as well as eliminate corrosion. Variable feed rates are provided through use of D C electronic motor drive. Included also are multi-circuit timers for accurate control of spot heating applications and replaceable stainless steel centers which permit fast conversion for greater work variety.

The portable monitor control panel consists of two units—the control section and the power section. This design permits back to back mounting or side by side for wall mounting. A portable heating station is offered in 7½ to 30 KW with high-frequency line contactor station or a 50 KW without high frequency line contactor. The unit may also be easily mounted on special tooling or interlocked with other heating stations.

For further information circle No. 35

Wider Burner Range

With the new addition of 3 in. and 4 in. air pipe sizes, North American Manufacturing Company now offers a range of 1½ in. to 4 in. in its Series 223 XSA Burners. The 4 in. Gas Burner and the 4 in. Dual-Fuel Burner are shown. When combined with the Series 4423 Gas Burner, the XSA line achieves a total range of ¾ in. to 4 in. air pipe size.

High stability is obtained when using this sealed-in nozzle mixing burner, which gives dependable operation whether burning gas or light oil. A flame safety feature is optional. Burner design is for application where large amounts of excess air are advantageous in securing temperature uniformity. However, it works equally well at normal air-fuel ratio or at rich ratios up to 50%, provided the additional air needed for nearly complete com-

bustion is in the combustion chamber.

The 4 in. burner can have its fuel input turned down from 2,560 cfh



4 in. gas burner



4 in. dual gas burner

of natural gas or 19 gph of light oil to 23 cfh or 3.4 gph when using 16 psi air pressure. This results in an available heat turndown ratio of 70 to 1 in a 900 F. furnace. The hot mix temperature then issuing from the tile is less than 950 F. and both gas and oil flames are entirely within the tile.

At an air pressure of 16 psi, a range of 354,000 to 2,600,000 Btu is available in the five Dual-Fuel sizes. For the six straight Gas sizes, the range is 354,000 to 3,250,000 Btu.

For further information circle No. 36

ROLOCK® FABRICATED ALLOYS HEAT AND CORROSION RESISTANT

some need 'em **HEAVY**, some prefer 'em **LIGHT**
but everybody benefits from
BALANCED DESIGN FEATURES
ROLOCK FURNACE BASKETS



Most of our customers, naturally, insist that furnace baskets be rugged, with more-than-ample safety factors . . . and maximum service life.

But Rolock's long and specialized engineering experience shows that no one design concept can meet all service conditions . . . and that sheer weight in heavy castings or oversize sections does NOT insure either safety or long service. Where reduction can be achieved in the weight of baskets and fixtures, this means more "payload" and lower fuel costs.

That is why Rolock designs and builds baskets to meet the individual customer's job needs, using many **PROVEN** basic design features pioneered by us in this field . . . corrugated, plain sided, or perforated . . . with or without Rolock pressure-welded grids and screens . . . in types and sizes for all popular pit-type furnaces . . . or with custom features to meet special requirements.

Rolock experience can be extremely helpful in cutting furnace-hour basket costs . . . in suggesting how to expedite flow of work . . . in aiding efficient quality control. Write us and see.

SALES AND SERVICE REPRESENTATIVES FROM COAST TO COAST
ROLOCK INC., 1332 KINGS HIGHWAY, FAIRFIELD, CONN.

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

3RL608

For further information circle No. 37

NEWS TO HEAT TREATERS

Ipsen Manual Available

A new 50-page illustrated manual titled *Fundamentals of Vacuum Heat Treating* discusses the basic considerations that apply to heat treating furnaces and the various techniques of vacuum metallurgy. This manual, available at \$2.00 per copy, has just been published by Ipsen Industries, Inc., Rockford, Illinois.

For those considering the problems of treating stainless steels, high

speed steels, and the exotic metals, this book is timely and helpful. Beginning with a discussion of vacuum pressures and terminology, various types of vacuum pumping systems, gauges, valves, and cold traps commonly used with vacuum furnaces are described. Illustrations show their construction and operation along with the factors that determine their selection for specific applications.

The basic design and construction of vacuum heat treating furnaces is considered in detail, includ-

ing single and two-zone muffle and retort hot wall units, as well as cold wall units. Details include a description of control systems as well as a step by step sequence of operations in a vacuum heat treating cycle. Annealing, hardening, tempering, sintering, and brazing under conditions of vacuum are detailed and many specific examples are cited.

The 50-page vacuum heat treating manual includes 7 tables and charts, 15 drawings, 5 illustrations, a glossary of terms, and conversion factors for commonly used vacuum terms.



Unique General Alloys'

WROUGHT-CAST RADIANT TUBES

give consistent long life

General Alloys' combination Wrought-Cast Radiant Tube Assemblies give consistent long life because they combine a cast return bend with straight tubes made from rolled and welded plate.

This design utilizes the erosion resistance of the casting where it is most needed . . . at the return bend. The uniform wall section of the plate forming the straight tube, and its smooth interior surface, prevent "hot spots" and "carbon build-up" that are the prime causes of erratic tube life.

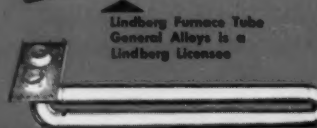
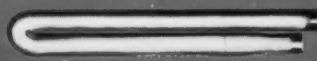
General Alloys Company is unique as a major producer of both castings and fabrications and therefore can recommend, without bias, the type of construction best suited for your needs.

For complete data, quotes, or engineering service contact the office nearest you . . . or write General Alloys Company, 390 West First Street, Boston 27, Massachusetts.

Ask about how our tube repair service can save you money!

GENERAL ALLOYS CO.

the only producer of both heat resisting castings and fabrications



General Alloys Company also produces entirely cast, as well as entirely fabricated radiant tube assemblies, in all the heat resisting alloys for every purpose and in every size.

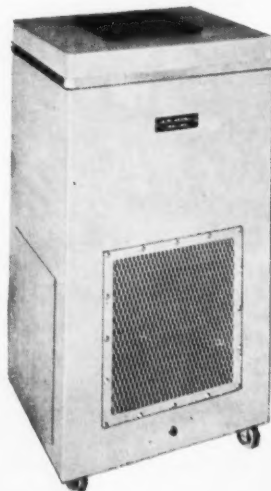
QUALLOYS

X-ite

For further information circle No. 38

So-Low Chilling Units

A. M. Harris Industries, Inc., Cincinnati, has announced its new Model DCA-60 chilling unit. This cabinet is specifically designed for firms requiring only part time testing, treating, storing, preserving or production chilling.



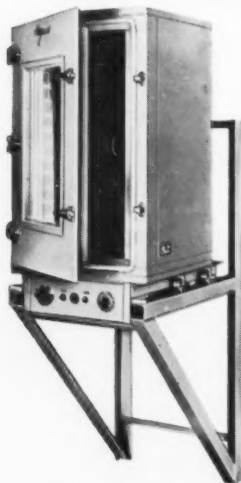
The cabinet is all steel construction with outside dimensions of 43 in. by 20 in. by 24 in. It operates on 230 volt 60 cycle 1 phase power and has a temperature control of -70 F. to -130 F. Thermal capacity is rated at 400 BTU per hr. at -120 F.

For further information circle No. 39

Testing Under Heat

The Electric Hotpack Company has developed a new oven to permit continual heating of test materials during stress measurement trials. Temperature range of the unit is 35 C. to 150 C. . . . ± 0.5 C. A wheel and track assembly allows the unit to roll in and out of the stress tester with ease. Ceiling and floor openings permit insertion of stress tester jam clamps.

Controls include a wattage selector switch and automatic thermostat, plus an over-temperature controller which cuts heater circuits in the event temperatures exceed thermostat settings.



The remote mounted temperature recorder responds to instant temperature changes. Forced air circulation provides uniform heat distribution. As an added feature a glass door permits constant view of chamber without disturbing internal environment. The unit is packaged in an enameled steel cabinet with stainless steel chambers.

For further information circle No. 40

Japanese Expansion Plans

Adding to the existing heat treating facilities installed in 1959, construction has been started at the plant of Nippon Kokan K.K. in Tokyo to complete a continuous wide plate heat treating line.

Designed by Drever Company, Bethayres, Pennsylvania, the new equipment to be installed includes pressure quench, tempering furnace and related conveyor tables. In combination with the previously installed charging table, hardening furnace and discharge table, the line will continuously normalize and temper widths up to 126 in. by 45 ft. long and up to $2\frac{3}{4}$ in. thick. Heavier plate in narrower widths will also be handled.

Full operation of the facilities is scheduled for early 1961.

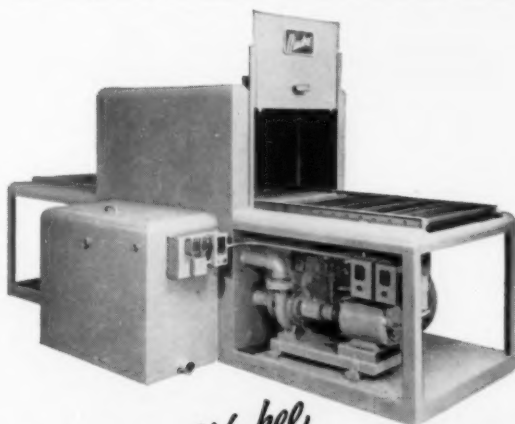
For further information circle No. 41

High Vacuum Tester

A hardness tester designed to make multiple indentations in reactive or heat sensitive metals at temperatures up to 1,600 C. at pressures in the order of 10^{-5} mm Hg. absolute has been announced by Vacuum Specialties Company, Somerville, Massachusetts.

The indenter in the unit is a sapphire point on a molybdenum rod with a 2 kilogram weight. This assembly is mounted on a cross feed table operated from outside the

Continued on page 40



There's a standard *Waukee*® WASHER TO MATCH YOUR CARBONITRIDER OR CARBURIZER!

Whatever the size of your carbonitriders or carburizers, the new Waukee Washer has a standard size to match it. Size range: 24 x 36 x 18 — 24 x 48 x 24 — 30 x 48 x 24 — 36 x 48 x 24.

COMPLETE — NO "EXTRAS" — Waukee parts washers come to you complete, ready to locate, connect to utilities, and begin operation. No "extras" to buy and install. Pumps, burners, controls are designed as integral parts of the Waukee Washer. You use your present furnace work-baskets, too.

FLEXIBILITY — You gain in flexibility with Waukee Washers. Standard units are available in "in-and-out" feed or straight-through, conveyor type, and in one, two, or three stages with rinse and dry. High-efficiency with gas, electricity, or steam.

THOROUGH CLEANING — The smallest Waukee Washer sprays a minimum of one ton of hot detergent solution through the load each minute. Solution penetrates work basket from top and bottom, washes away oil and foreign matter from the densest charge. Bull's-eye timer cycles the load for complete washing without guesswork or waste of time.



Complete data in
Bulletin 1201
— write
for it today.

Waukee-washed parts are free of cutting and quenching oils, mean clean furnace atmospheres, therefore predictable case depths and cleaner, brighter work.

Waukee ENGINEERING CO.

5137 N. 35TH ST., MILWAUKEE 9, WIS.

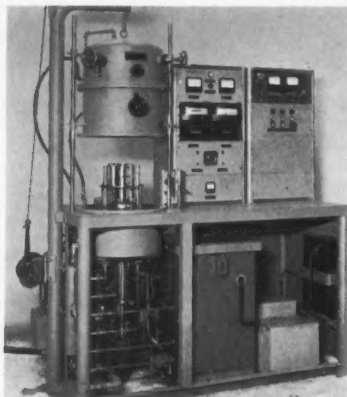
MAKERS OF WAUKEE GAS FLO-METERS • MIXORS • COMPRESSORS

For further information circle No. 42

NEWS TO HEAT TREATERS

Continued from page 39

vacuum chamber, with micrometer adjustments, so that many closely spaced indentations can be made on one or more samples held in the anvil without losing temperature or vacuum.



The molybdenum anvil is raised by a hydraulic mechanism to weight the indenter. It descends completely out of the hot zone for loading and unloading samples.

The hot zone consists of a tantalum resistance heating element surrounded by a group of tantalum and stainless steel heat shields. The maximum temperature obtainable is in excess of 2,000 C.

For further information circle No. 43



A few of those who helped man the MTI Texas Chapter commercial heat treating display at the recent Dallas ASM Metal Exposition, are, left to right: Kenneth Ward, Lone Star Heat Treating Corp.; Clifford Cook, Cook Heat Treating Company of Texas; L. J. Van Dorfy, Lone Star Heat Treating Corp.; M. B. Dominy, Dominy Heat Treating Corp.; C. E. Herington, Metal Treating Institute; M. J. Parker, United Heat Treating Company; John Ross, Dominy Heat Treating Corp.; James Blanchard, Houston Heat Treating Company, Inc.

MTI Display

For the first time in the history of the MTI a chapter unit cooperated in presenting a display booth promoting the use of commercial heat treating services to industry. This booth was a part of the Dallas Southwestern Exposition held by the American Society for Metals May 9 to 14.

Six companies comprising the membership of the Texas Chapter of MTI contributed equally to share the expense and to provide manpower for the booth. At the end of the 5 day show it was the unanimous opinion of all contributors

that this was a worthwhile cooperative project and emphasized the value of membership in the industry's trade association.

The illustration shows some of those who made themselves available to greet visitors, answer questions and discuss heat treating problems. Not shown, but who, nevertheless, gave liberally of their time were Leon Saunders of United Heating Treating Company and Charles Dominy of Superior Heat Treating Company, Inc. The special confederate vests worn only by those associated with the booth were one of the show's outstanding attractions.



WHAT WOULD YOU DO?

Concluded from page 19

exists only when we decide we need a regular man at it. If we replaced the inspector there wouldn't be enough work for some of the higher-rated men and we'd have to lay off one of them."

Eventually the case went to arbitration under the rules of the American Arbitration Association.

What Would YOU Do?

THE AWARD. The arbitrator made three points:

1. When a man leaves a job, there is a presumption that a vacancy exists. It might be that a job disappears at the same moment that the person holding it leaves, but that would be a rare coincidence. As long as management expects that someone will have to do the work of the inspector, even if only part-time, the vacancy exists. 2. The provisions for employees to bid into a vacant job in accordance with seniority is a valuable contractual right. It might be inconvenient for the company but that is part of the bargain. It wouldn't be fair to deprive employees of their opportunity for promotion, particularly as the union may have given up other demands for the sake of this benefit. 3. The fact that men in some of the higher classifications may have to be laid off if they are not permitted to do the inspector's work is immaterial. The contract provides for layoff by seniority when work becomes slow, and that is the way the problem must be solved.

NEW HEAT AND COLD TREATMENT

Concluded from page 14

to reform and lose its springback tendency.

Following the use of sub-zero temperatures, parts are usually accurate within tolerances of ± 0.0020 in. and will retain their dimensions if furnace aged without dies.

Company engineers say virtually all types of stainless steel stampings and machined parts with either simple or complex configurations can be cryoformed within the elastic limits of their respective alloys. If true, this should open many fields for design engineers. One example would be making it practical to use curved stainless corrugations with multiple radii and very close tolerances.

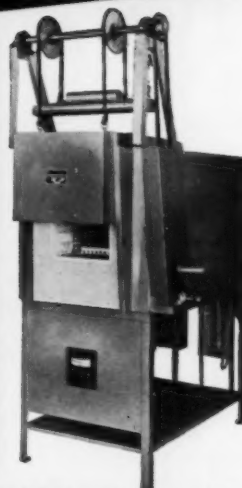
Cryoforming differs from die-quenching techniques used by other airframe manufacturers to the extent that it does not involve the use of presses or clamping fixtures with relatively expensive dies which are preheated to 1,000 F. or more, in order to handle heat treated parts in the same temperature range. Because of this difference it is not only less expensive, but also permits the elimination of warpage in many stainless steel components which are too large for available press facilities. • • •

HUPPERT Floor Model Furnaces

Built in 28
Standard Sizes

- Continuous operation to 1850°F. — intermittent to 1950°F. — for 2300°F. on special order.
- Complete with indicating electronic controller.
- Tight-sealing, wedge-type door.
- Standard for 220 V. AC, single or 3 phase operation—110 V. or 440 V. on special order.
- Multi-insulation for maximum efficiency.

Request literature
on complete line of
Huppert Furnaces



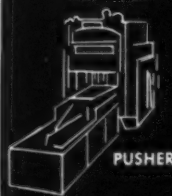
Model No. 16 Illustrated
Inside Dimensions 12" W. x 8" H. x 18" D.
\$1050.00 complete

K. H. HUPPERT CO.
Manufacturers of Electric Furnaces and Ovens

6849 Cottage Grove Avenue, Chicago 37, Illinois

For further information circle No. 44

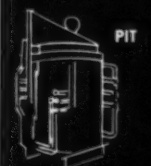
MEET ALL TYPE FURNACE FIXTURE NEEDS... ECONOMICALLY.



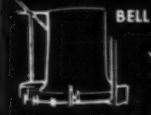
PUSHER



SALT



PIT



BELL

No matter what type of heat treating furnace you have . . . complex or simple . . . a Wiretex-made fixture will handle it easier, better and at less cost.

Fixtures • Retorts • Baskets
Pots • Trays • Boxes • Grids
Screens • Muffles • Etc.

Any form, size, weight, strength, mesh, alloy or quantity.

Cost Conscious? Call Wiretex. Ask for Catalog M7.

Specialists in Processing Carriers Since 1932.

Wiretex mfg. co.,

16 Mason Street, Bridgeport 3, Conn.

For further information circle No. 45

the ACCURATE WAY to test MICRO and MACRO hardness



Wilson TUKON
hardness tester

• Wilson TUKON testers make and measure extremely shallow indentations. They are used, for example, by manufacturers of watches, hairsprings, needles and jewels. In laboratories, TUKON instruments test individual crystals or microscopic particles. On any job, they provide these important advantages:

Accuracy—Precision-built TUKON testers give consistently correct results. Loads are applied without friction or impact—Bausch & Lomb optical equipment is standard—vibration is closely controlled.

Long life—Simple design, rugged construction make TUKON testers as durable as a machine tool.

Easy operation—Even an unskilled operator can get perfect readings after a short training period.

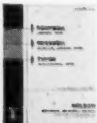
Supplied complete—Special accessories for various sizes and shapes.

A complete line of Wilson Rockwell instruments is available, including semi and fully automatic models.



Wilson "Brule" Diamond Penetrators
Each diamond is cut to an exact shape. A comparator check and microscopic inspection of each diamond assure perfect readings every time.

Write for details—Ask for Catalog RT-58. It gives complete information on the Superficial tester as well as on the full line of Wilson Rockwell hardness testers.



WILSON "ROCKWELL" HARDNESS TESTERS

Wilson Mechanical Instrument Division
American Chain & Cable Company, Inc.

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For further information circle No. 46



ABOUT PEOPLE

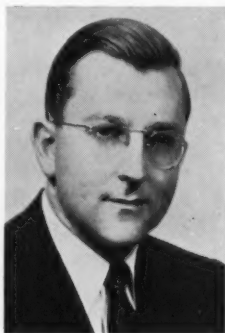
Continued from page 35

ments in both large and small companies. He recently resigned the positions of executive vice president of Aeroprojects, and president of Sonobond Corporation.

Moves at Crucible

Eugene A. March, formerly assistant works manager at the Crucible Steel Company's Midland plant, has been appointed the company's director of metallurgy. He succeeds E. T. Walton who will retire in June.

The position vacated by March at Midland Works will be filled by Lawton Howell, formerly assistant controller in Crucible's general offices in Pittsburgh.



Eugene A.
March

March joined Crucible in 1946 as metallurgist in the mill control division at the company's Sander-Halcomb works in Syracuse, New York. He became foreman of the rolling mill in 1948. In 1950 he was selected as chief metallurgist in the melting department. He was named general supervisor of metallurgical control two years later. March has also served Crucible in the capacities of chief works metallurgist and assistant works manager.

March was transferred to Midland Works in 1958 as chief metallurgist. Last October he was appointed assistant works manager.

He is a member of the Association of Iron and Steel Engineers,

METAL TREATING

American Society for Metals,
American Iron and Steel Institute,
American Ordnance Association,
and American Management Association.

Carpenter Steel Manager

Thomas E. Murphy has been appointed by The Carpenter Steel Company, Reading, Pennsylvania, as assistant manager, tool steel sales division, with headquarters in the Reading office.



Thomas
E. Murphy

In his new position, he will assist the manager of tool steel sales in promoting the sale of tool steel. Previously, he served for three years as a sales representative assigned to Carpenter's Woodside, Long Island, New York branch warehouse.

Murphy graduated from St. John's University, Brooklyn, New York, with a BBA in marketing.

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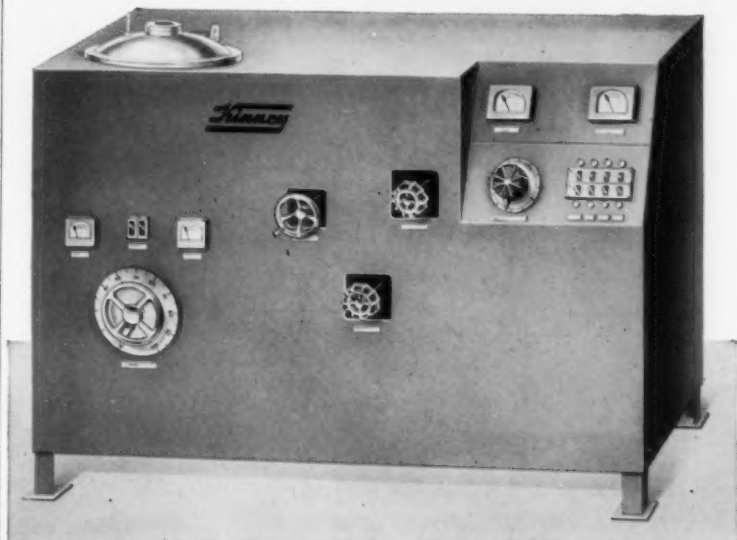
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For further information circle No. 47

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Lucifer Furnaces, Inc., manufactures many standard electric heat treating furnaces and maintains a design department to create special units. For engineering assistance, parts or production information write or call . . .

LUCIFER FURNACES, INC.

Neshaminy 21, Pennsylvania

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For further information circle No. 48

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Neutral Atmosphere

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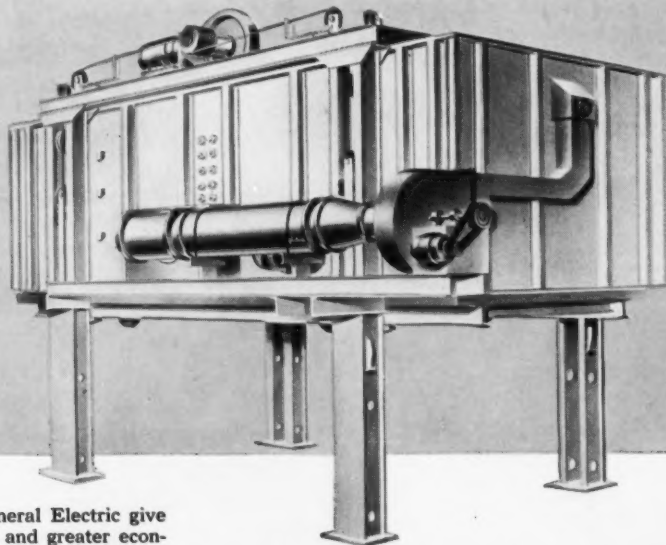
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For further information circle No. 49

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for stress relieving and annealing



Electric Elevator Furnaces from General Electric give you higher quality, increased production, and greater economy in stress relieving and annealing of heavy batch loads. Particularly well-suited for loads which require fairly long heat treating cycles, these furnaces provide minimum cycle length and accurate, reproducible heat treating cycles. Uniform heat distribution and accurate temperature control are assured by proper insulation, correct distribution of heating units, and gas-tight heat seal. Elevated design gives extra floor space and flexibility of operation; eliminates operator heat discomfort. Longer life results because furnace components are stationary and load is eased into place.

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For further information circle No. 50

HEATING ELEMENT MATERIAL

RESEARCH

Although the use of atmospheres in electric heat treating furnaces offers worthwhile advantages so far as finished quality of work is concerned, many of the gaseous mixtures introduced or created during such operations impose very stringent requirements upon the materials used in furnace construction—particularly the heating elements.

One of the most widely used industrial heating element materials has been the 80-20 nickel-chromium resistance alloy, for high temperature applications ranging from 1,800 F. to 2,150 F. chamber temperature; and a special 35-20 nickel-chromium-iron composition, for furnaces operating in the critical intermediate temperature range between 1,500 F. and 1,800 F.

When using these alloys, however, with reducing atmospheres, all contaminants should be removed from the work as well as the furnace before starting up to eliminate or at least minimize the formation of harmful foreign gases. With carburizing atmospheres, it is important that carbon potentials be kept at the lowest possible level required for the work—and that special care be taken to avoid overheating, even for short periods of time.

Because of the need for such precautionary measures, as well as the increasing use of atmospheres in heat treating operations, Hoskins Manufacturing Company, Detroit, has devoted considerable effort during the past five years to the development of a new, improved heating element alloy capable of withstanding the adverse conditions encountered in reducing and carburizing atmospheres, at chamber operating temperatures up to 2,150 F.

This metallurgical research and development program established that only one of over 200 different experimental compositions was found to be significantly superior in all respects to the standard high temperature 80-20 nickel-chromium resistance alloy now in widespread use. The new composition, designated Chromel-AA, is itself a modified 80-20 type nickel-chromium alloy made unique by the addition of minor percentages of iron, silicon, cobalt, manganese and columbium.

Test data indicated that Chromel-AA possesses considerably greater resistance to carbon pick-up at all temperatures than any other presently known heating element alloy. In addition, it also appears to have greater high temperature resistance to corrosion in

reducing atmospheres than other commonly used heating element alloys. It resists the attack of sulfur, chlorine and other harmful contaminants often present, intentionally or accidentally, in controlled atmospheres. Moreover, it is not susceptible to "green rot"—a preferential intergranular oxidation of the chromium which is frequently encountered under certain conditions with other alloys in the critical intermediate temperature range between 1,500 F. and 1,800 F.

RESISTANCE TO CARBURIZATION

Exposure: 80 hours at 2150° F. in an atmosphere having a 1% carbon potential at 55° F. dew point.

ALLOY	% CARBON PICK-UP
Hoskins Chromel-AA	.48%
Std. 80-20 Ni-Cr	.84%
35-20 Ni-Cr-Fe	1.70%

RESISTANCE TO SULFUR CORROSION

Exposure: 2 hours at 1600° F. in a reducing atmosphere containing 10% H₂S and balance hydrogen.

ALLOY	% SULFUR PICK-UP
Hoskins Chromel-AA	.39%
Std. 80-20 Ni-Cr	.73%
35-20 Ni-Cr-Fe	.39%

TABLE 1. Representative test results showing carburization and corrosion resistant properties of alloys in controlled atmospheres.

TENSILE STRENGTH AND ELONGATION	
21 gauge (10.95" dia.) annealed wire	
TEMPERATURE	TENSILE STRENGTH ELONGATION
40° F.	120,000 psi 30%
1200° F.	90,000 psi 30%
1800° F.	57,000 psi 30%
2100° F.	35,000 psi 30%
2100° F.	13,000 psi 10%

STRESS RUPTURE PROPERTIES	
14 gauge (1.064" dia.) annealed wire	
TEMPERATURE	STRESS TO RUPTURE 10 TO 100 HOURS
1200° F.	11,000 psi 9,000 psi
1800° F.	9,000 psi 4,700 psi
2100° F.	7,000 psi 2,300 psi

BOND-ROBUST PROPERTIES	
14 gauge (1.064" dia.) annealed wire	
TEMPERATURE	STRESS TO SEPARATE CRISP BALLS 1000 HRS
1200° F.	7,000 psi 13,000 psi
1800° F.	5,500 psi 4,000 psi
2100° F.	400 psi 1,200 psi

TABLE 2. Physical and mechanical properties of Chromel-AA.

Because of its somewhat higher electrical resistivity, Chromel-AA is not always directly interchangeable size-for-size and length-for-length with standard 80-20 nickel-chromium or 35-20 nickel-chromium-iron heating element alloys. A suitable method of converting existing furnaces from elements of either of these materials to Chromel-AA elements, however, assumes equal resistance for the two alloys at the operating temperature of the equipment. For wire elements, the relationship is given by:

Continued on page 46



PERECO vertical TUBE FURNACE

with
KANTHAL
SUPER
heating elements

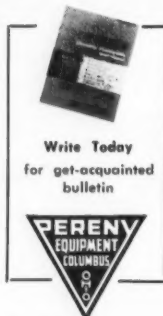
Incorporating KANTHAL SUPER heating elements this Model MTKS-312 Pereco Vertical Tube Furnace is designed for precise, wide-range control of temperatures to 1600°C. A 12" long hot zone is provided in a 3" I.D. x 30" impervious Mullite tube with the "Super" elements mounted vertically and parallel to its main axis. Counter-balanced, vertical-lift loading column is manually operated. Reactor "package," strip chart recorder and controls are mounted in matching cabinet. Write for complete details.

Pereco builds standard or special furnaces for temperatures from 450°F. to 5000°F.

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For further information circle No. 51



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Write for Bulletin 120 and 132

NIAGARA BLOWER COMPANY

Dept. MG-8, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

For further information circle No. 52

HEATING ELEMENT MATERIAL RESEARCH *Concluded*

$$\frac{(RL)}{(D^2)} \\ \text{Chromel-AA} = \frac{(RL)}{(D^2)}$$

where R=Resistivity at operating temperature
L=Length of the wire
D=Diameter of the wire

If the total radiating surface is to be held constant after conversion, the following conditions must also be met:

$$\frac{(DL)}{(D^2)} \\ \text{Chromel-AA} = \frac{(DL)}{(D^2)} \\ \text{Present Alloy}$$

To convert furnaces to Chromel-AA Strip, the following formula applies, again assuming equality of hot resistance:

$$\frac{RL}{WT} \\ \text{Chromel-AA} = \frac{RL}{WT} \\ \text{Present Alloy}$$

where R=Resistivity at operating temperature
L=Length of strip
W=Width of strip
T=Thickness of strip

The total radiating surface can be kept approximately constant by varying only the thickness of the strip to compensate directly for differences in hot resistivity.

If it is desired to take advantage of the higher resistivity of Chromel-AA to reduce the total length (and weight) of strip required at the same nominal size, the formula is:

Length of Chromel-AA = Length of Present Alloy x

Resistivity of Present Alloy at operating temperature

Resistivity of Chromel-AA at operating temperature

Example: Assuming 100 ft. of 80-20 nickel-chromium strip 1 in. by .050 in. and operating at 2,000 F. to be converted to 1 in. by .050 in. Chromel-AA Strip

$$\begin{aligned} &\text{Length of} \\ &\text{Chromel-AA} = \\ &= \\ &\quad (100 \text{ ft. by } (1.06) (510 \text{ ohms} \\ &\quad \text{per smf}) \\ &\quad (1.07) (550 \text{ ohms per smf}) \\ &\quad 92 \text{ Feet of Chromel-AA Strip} \end{aligned}$$

In view of the results obtained from extensive laboratory tests and actual applications in the field, Chromel-AA has now been released for general commercial use in all controlled atmosphere furnaces at all chamber operating temperatures up to 2,150 F.

METAL TREATING

MANUFACTURERS' LITERATURE

For your copy circle
the number on the
Readers' Service Card

Annealing Aluminum Coil at American Screen Products is featured in Vol. 19, No. 2 of Sunbeam Metal Minutes. The liberally illustrated brochure gives readers a valuable insight to the processes involved in the close tolerance operation. Steps described include: preparation for fabrication, furnace capacity, dimensions, combustion system, design features, and the operation itself.

For further information circle No. 53

The American Technical Society has published **Ferrous Metallurgy Laboratory Manual**, by Joseph S. Umowske. It is a study which is a must in every metal treater's library. The manual is intended primarily to serve those individuals who require more than textbook information on the heat treatment of steels. However, it also has a special value to technical personnel who have had little or no investigative experience in a laboratory. Through this book the reader can become familiar with the scientific approach and reporting of an investigation as well as acquire the skills necessary in operating the equipment in a metals laboratory. **Ferrous Metallurgy Laboratory Manual** is listed at \$2.25.

For further information circle No. 54

Thermochrom Crayons and Detectotemp Paints is the title of a colorfully illustrated brochure outlining the many uses of these products of the Princeton Division of

Curtis-Wright Corporation. The brochure comes in handy fold-out form permitting posting on walls and bulletin boards for ready reference.

For further information circle No. 55

Alloy Fabrications is a 4 page illustrated brochure showing the many uses of the products and facilities of Alloy Engineering Company, Berea, Ohio. The brochure briefly outlines Alloy's three major functions as designers, engineers, and fabricators. Also lists facilities for shearing, punching, breaking, rolling, welding, and fabricating.

For further information circle No. 69

Vacuum Specialties Company, Somerville, Massachusetts has released a booklet describing the **Advanced Process Equipment for Production and Research** which the firm specializes in. The glossary of photos, showing many special units covers the nuclear field, reactive metals, high temperature furnaces, high vacuum coating equipment and miscellaneous special equipment available to customers. Contains a brief history of the firm, its present facilities and plans for the future.

For further information circle No. 56

Norton Company has published a 24 page booklet titled **Hot Rods for Electric Furnaces and Kilns** which covers the entire scope of operation from technical data through a handy temperature conversion chart for use with crystolon heating elements. The many graphic illustrations give minute details of

all phases of the operation. An 8 page chart of physical and electrical specifications makes the booklet one of the handiest reference guides in the industry.

For further information circle No. 57

Bulletin B-81 of the Drever Company, Bethayres, Pennsylvania, gives a complete background of how that firm has continued to meet the increasing demand for stainless steel in every form. The 16 page booklet shows how Drever Company can and does meet greatly varying demands for every type of stainless steel, strip, sheet, tube, wire, bar, and formed and machined products. The booklet is illustrated with 20 pictures of the various pieces of equipment and facilities this firm uses in its process. **Bulletin B-101**, also available, illustrates Drever's facilities for sintering powder metal products. Lists the many units available as well as their standard sizes and capacities.

For further information circle No. 58

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For further information circle No. 59

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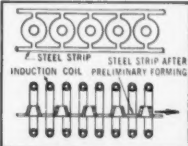
TYPICAL INDUCTION HEATING APPLICATIONS

PLASTIC COATING OF TOOL HANDLES



A production line operation for coating handles of tools at Whitney Metal Tool Co., Rockford, Ill. uses induction heating with excellent results. The handles only are heated by induction to the desired temperature then dipped into a vinyl chloride base coating material for a short period depending upon the thickness of coating desired. The plastic coating formed on the handles is then cured by immersion in a carbo-wax bath.

FORMING OF METAL STRIP FACILITATED BY PROGRESSIVE ANNEALING



Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

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For further information circle No. 60

MANUFACTURERS' LITERATURE

Illustrated Bulletin EF-260, published by Harper Electric Furnace Corp., presents the updated and expanded line of Harper elevator furnaces equipped with neoprene-

sealed retorts. As well as containing tabulated specifications covering the 32 model line, the bulletin describes chief operating features of the furnaces in providing low dew points for brazing, annealing, hardening and sintering at temperature up to 2,300 F.

For further information circle No. 61

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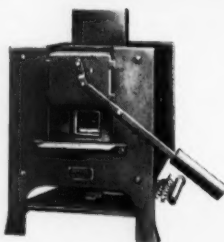


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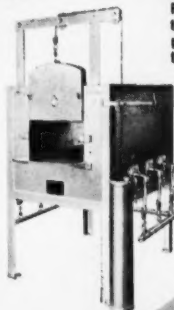
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
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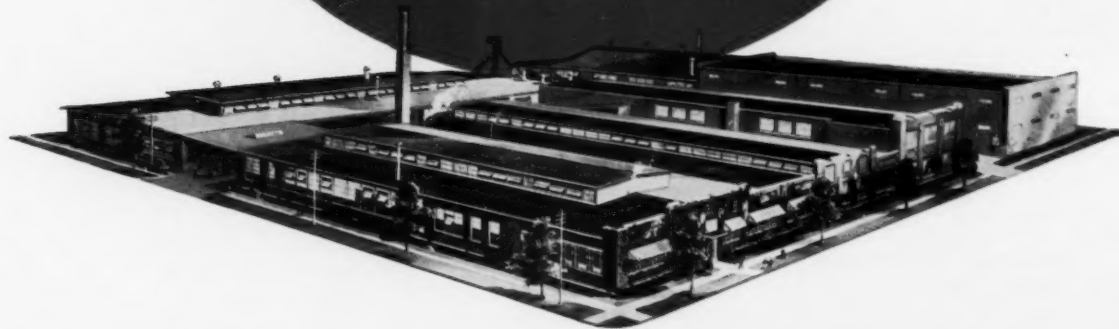
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For further information circle No. 64

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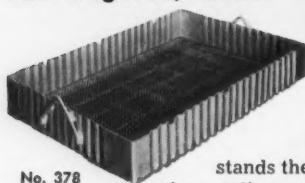
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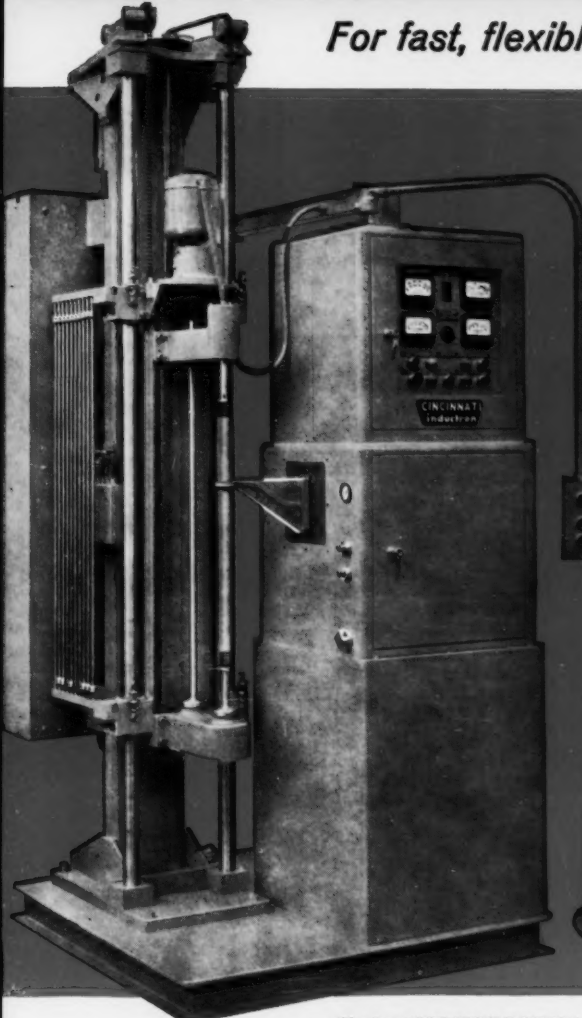
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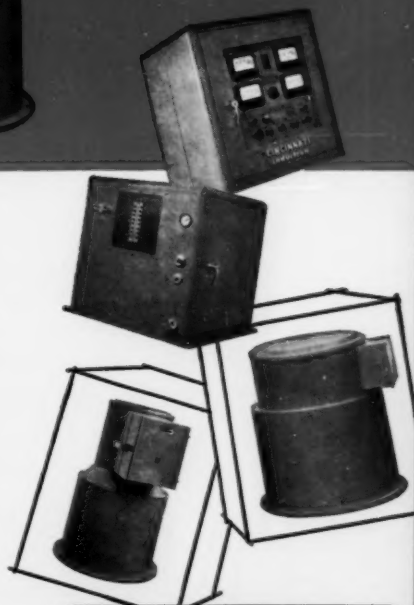
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